Obsessive-Compulsive Disorder (OCD) resources and conceptualisation

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June 18, 2023

1 The Definitions of the Concepts of OCD ontology

The identification of OCD knowledge has been conducted through the utilization of DSM-5, assessment criteria (Y-BOCS), and literature review. The subsequent discussion presents the key concepts identified in the DSM-5, followed by their definitions in the DSM-5 and assessment tools if available, and finally, an overview of the findings from the existing literature.

The DSM-5 serves as a primary source for understanding OCD, providing comprehensive information on various concepts. When available, the definitions of these concepts in the assessment tools are also included to enhance clarity. Additionally, the literature review helps to supplement and validate the knowledge obtained from the DSM-5 and assessment criteria.

By combining information from these resources, a comprehensive understanding of the main concepts related to OCD can be achieved, ensuring a solid foundation for further investigation and analysis in the field.

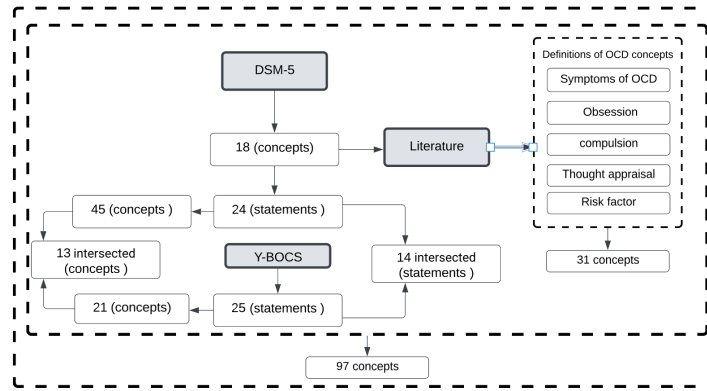Figure 1 illustrates the number of concepts and statements collected about OCD from these resources.

Figure 1: The concepts and statements of OCD form DSM-5, assessment tool and literature

The concepts highlighted/identified from DSM-5 are illustrated in table 1.
We identified the definitions of each concepts in the table 1 from DSM-5 first, then assessment tools, then the literature..

(1) The statements of OCD from DSM5

(1) OCD	(2) Obsessive-Compulsive and Related Disorders (OCRDs)
(3) Obsession	(4) Compulsion
(5) Contamination obsession	(6) Symmetry obsession
(7) Cleaning compulsions	(8) Ordering and counting compulsions
(9) Aggressive obsession	(10) Religious obsessions
(11) Sexual obsession	(12) Checking compulsions
(13) Diagnostic criteria	(14) Specifiers (dysfunctional belief)
(15) Risk and Prognostic Factors	(16) Functional Consequences of Obsessive-Compulsive Disorder
(17) Comorbidity	(18) Trigger

Table 1: The concepts of OCD from DSM-5. Note: each concept/class has numberes of related concepts, for example compulsion has "mental act" and "compulsive behavior". Those will be identified from the definitions of those concepts.

1. Obsessive-Compulsive Disorder sits under its own category of (OCRDs).

2. OCD is characterized by the presence of obsessions and/or compulsions or both.

3. OCD has number of risk factors, namely, Temperamental,Environmental, Genetic and physiological, Culture-Related Diagnostic Issues,Gender-Related Diagnostic Issues and Suicide Risk

4. OCD is associated with reduced quality of life as well as high levels of social and occupational impairment.

5. Individuals with OCD often have other psychopathology.

The statements of OCD from literature
In this study, our objective was to expand upon the existing symptoms of Obsessive-Compulsive Disorder (OCD) as defined in the DSM-5. To achieve this, we conducted a search using PubMed as our primary database. Our search was focused on the key terms "OCD" and "Symptoms."

By employing this approach, we aimed to identify any additional symptoms or manifestations of OCD that might not have been included in the DSM-5 diagnostic criteria.

Through a review of the literature, we uncovered a range of symptoms experienced by individuals with Obsessive-Compulsive Disorder (OCD) that go beyond the symptomatology outlined in the DSM-5. Our investigation revealed that OCD manifests not only through cognitive symptoms but also through various physical manifestations. In addition to the well-established cognitive symptoms, such as intrusive thoughts and repetitive behaviors, our findings indicated the presence of physical symptoms among individuals with OCD. These physical symptoms include but are not limited to skin-related symptoms and weight loss symptoms, among others [1] [2] .

The main concepts that been highlighted from previous knowledge are shown in table 2.
(2) The statements of OCRDs from DSM5

1. A group of conditions. This group of conditions now includes: Obsessive compulsive disorder (OCD), body dysmorphic disorder (BDD), trichotillomania (TTM; hair-pulling disorder),

OCD, OCRDs, Obsession, Compulsion, Risk factor,
Functional impairment and Symptom.

Table 2: The identification of concepts form previous definitions of OCD.

excoriation (skin-picking) disorder, hoarding disorder, substance/medication-induced OCRD, OCRD due to another medical condition, and other specified OCRDs.

Given our specific focus on modeling and representing the knowledge of (OCD), it is important to acknowledge that our search process was not exhaustive in terms of investigating other (OCRDs). The identification of concepts from the statements of OCRDs is shown in table 3.

Body dysmorphic disorder (BDD), trichotillomania ,
excoriation (skin-picking) disorder, hoarding disorder,

Table 3: The identification of concepts form previous definitions of OCRDs.

(3) The statements of Obsession from DSM5

1. Recurrent and persistent thoughts, urges, or images that are experienced, at some time during the disturbance, as intrusive and unwanted, and that in most individuals cause marked anxiety or distress.

2. The individual attempts to ignore or suppress such thoughts, urges, or images, or to neutralize hem with some other thought or action (i.e., by performing a compulsion).

3. The obsessions are time-consuming (e.g., take more than 1 hour per day) or cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

The statements of Obsession in Y-BOCS

1. Obsession is unwanted ideas, images or impulses that intrude on thinking against your wishes and efforts to resist them.

2. There are 7 types of obsession, namely, aggressive, somatic, symmetry, sexual, religious, contamination and doubt obsession.

The statements of the concepts (5)(6)(9)(10)(11)

The definitions of those concepts are not provided in the DSM-5. The following explains the definitions of those categories. The definitions are taken from Y-BOCS and literature [3] [4] [5].

Contamination obsession includes fear of germs, dirt and diseases.

Symmetry obsessions include a perceived need for things to be in a particular order or lined up in a certain way (eg, color coded), rewriting or rereading over and over because of a perceived need for handwriting to look "perfect" or a sentence to feel "just right," evening up (such as doing the same behavior with each arm to make it feel even or tying and retying shoelaces until the pressure feels the same on both feet), or needing the television volume or channel to be on an even or odd number.

Aggressive obsessions include uncomfortable ego-dystonic thoughts or urges to cause harm to oneself or others, including fears, impulses, or urges to touch hot surfaces such as stoves or fires;

fears of being around knives or other sharp objects because of images of picking them up and cutting or stabbing someone; urges to swerve a car or bicycle into oncoming traffic; and urges or fears of blurting out something aggressive or offensive (eg, racial epithets).

Religious obsessions (which do not require a religious background or belief to occur) include fears such as unintentionally or inadvertently offending God or blaspheming, fears of religious objects or symbols, and superstitious fears of symbols that have a religious history or meaning (eg, the fear that seeing the number 666 will result in something bad happening or harm coming to someone).

Sexual obsessions can present as repeated fears that one has inadvertently behaved in an inappropriate sexual manner, unwanted uncomfortable sexual images or thoughts, or repetitive intrusive fears that one is unknowingly of a different sexual orientation or gender.

Somatic obsession tend to fall into two primary types: unreasonable excessive fears that the person with OCD has contracted an illness (including noncommunicable illnesses such as cancer) and fears that something (often something indefinable) is wrong with a body part or feature.

Hoarding obsessions are explicitly due to obsessional fears (eg, contamination fears or fears of harm), and the items hoarded are more likely to be unusual or bizarre (eg, saving fingernail clippings for fear that someone could harvest DNA from them and cause harm to a person).

The identification of concepts from the statements of obsession is shown in table 4.

Aggressive obsession, contamination obsession, somatic obsession, symmetry obsession, doubt obsession, hoarding obsession, sexual obsession , religious obsession, thoughts, persistent thoughts, intrusive thoughts, obsessive thoughts, intrusive image, intrusive urge, urge, mental image, negative emotions, compulsion, obsession, duration level, functional impairment

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Table 4: The identification of concepts form previous definitions of obsession.

(4) The statements of Compulsion from DSM5

1. Repetitive behaviors (e.g., hand washing, ordering, checking) or mental acts (e.g., praying, counting, repeating words silently) that the individual feels driven to perform in response to an obsession or according to rules that must be applied rigidly.

2. The behaviors or mental acts are aimed at preventing or reducing anxiety or distress, or preventing some dreaded event or situation.

3. The compulsions are time-consuming (e.g., take more than 1 hour per day) or cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

The statements of Compulsion in Y-BOCS

1. There are 6 types of compulsion, namely, checking, cleaning, washing, ordering, counting, repeating and hoarding compulsion.

The identification of concepts from the statements of compulsion is shown in table 5.

(13) Diagnostic criteria in DSM5

1. Presence of obsessions, compulsions, or both

2. time-consuming, cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

> Compulsive checking, compulsive cleaning, compulsive counting, compulsive ordering, compulsive washing, compulsive hoarding, behavior, compulsive behavior, repeating rituals, repetitive behavior, mental act, activity, mental counting, mental calculation, mental praying, negative emotions, compulsion, obsession, duration level, functional impairment

Table 5: The identification of concepts form previous definitions of compulsion.

Diagnostic criteria in Y-BOCS

1. level of time occupied by obsessive thoughts

2. level of interference due to obsessive thoughts

3. Level of distress associated with obsessive thoughts

4. resistance against obsessions

5. degree of control over obsessive thoughts

6. time spent performing compulsive behavior

7. interference due to compulsive behavior

8. distress associated with compulsive behavior

9. resistance against compulsions

10. degree of control over compulsion

The identification of concepts from the statements of diagnostic criteria is shown in table 6.

> Diagnostic criteria, severity duration level (mild , moderate, severe , extreme), severity control level (mild , moderate, severe , extreme) , severity resistance level (mild , moderate, severe , extreme), severity interference level (mild , moderate, severe , extreme), severity distress level (mild , moderate, severe , extreme).

Table 6: The identification of concepts form previous definitions of diagnostic criteria.

(14) thought appraisal in DSM5

1. These beliefs can include an inflated sense of responsibility and the tendency to overestimate threat; perfectionism and intolerance of uncertainty; and over-importance of thoughts (e.g., believing that having a forbidden thought is as bad as acting on it) and the need to control thoughts.

dysfunctional belief / thought appraisal in the Cognitive theory of OCD

1. is expectations, interpretations, or evaluations of the meaning of particular phenomena such as unwanted intrusive thoughts [6] [7].

2. The work carried out by the Obsessive-Compulsive Cognitions Working Group (OCCWG), as mentioned in [8] has made an ongoing effort to identify the most important OCD-relevant appraisal domains. According to the OCCWG, there are six core OCD-relevant belief domains. (1) Importance of controlling though [8] [9] which means individuals with OCD often report the belief that complete control over their thoughts is both necessary and possible (2) Inflated responsibility [8] [7], which means individuals with OCD are thought to believe themselves to be personally responsible for the content of their obsessions as well as any possible disastrous consequences that might arise from their obsessions. (3) Intolerance of uncertainty which means individuals beliefs about the necessity of being certain. (4) Over importance of thought [6]. This means that, OCD sufferers report a belief that the mere presence of the thoughts makes those thoughts important and meaningful. (5) Overestimation of threat [7], which means individuals with OCD may show inflated beliefs about the probability and cost of aversive events [7] . For example, individuals with contamination fear may exaggerate the probability of becoming infected, as well as the severity of illness that will result. (6) Perfectionism [10], OCD is associated with an inability to tolerate mistakes or imperfection [10], such as a need to fill out a form without making a single mistake; or a need to repeat a routine action until it feels "just

The identification of concepts from the statements of dysfunctional belief is shown in table 7.

Thought appraisal, over importance of thought, intolerance of uncertainty , importance of controlling though, overestimation of threat and inflated responsibility.

Table 7: The identification of concepts form previous definitions of thought appraisal.

(15) Risk and Prognostic Factors in DSM5

1. Temperamental, greater internalizing symptoms, higher negative emotionality, and behavioral inhibition in childhood are possible temperamental risk factors.

2. Environmental, Physical and sexual abuse in childhood and other stressful or traumatic events have been associated with an increased risk for developing OCD.

3. Genetic and physiological, The rate of OCO among first-degree relatives of adults with OCD is approximately two times that among first-degree relatives of those without the disorder; however, among first-degree relatives of individuals with onset of OCD in chilldhood or adolescence, the rate is increased I0-fold.

4. Culture-Related Diagnostic Issues.

5. Gender-Related Diagnostic Issues

6. Suicide Risk

(16) Functional Consequences of Obsessive-Compulsive Disorder in DSM5

1. Impairment occurs across many different domains of life and is associated with symptom severity. Impairment can be caused by the time spent obsessing and doing compulsions. Avoidance of situations that can trigger obsessions or compulsions can also severely restrict functioning. In addition, specific symptoms can create specific obstacles. For example, obsessions about harm can make relationships with family and friends feel hazardous; the result can be avoidance of these relationships.

(17) Comorbidity in DSM5

1. Individuals with OCD often have other psychopathology, anxiety disorder, depressive or bipolar disorder and Comorbid obsessive-compulsive personality disorder.

(18) Trigger in DSM5

1. The trigger can be any of (people, places, situations) that can trigger obsessions or compulsions.

The identification of concepts from the statements of risk factor, Functional Consequences of OCD and comorbidity are shown in table 8.

> Functional impairment, social impairment, normal routine impairment, occupational impairment, relationship impairment, Comorbidity, anxiety disorder, depressive, bipolar disorder, Comorbid obsessive-compulsive personality disorder, trigger, food, place, .

Table 8: The identification of concepts form previous definitions.

The following discussion presents the concepts that have emerged from previous knowledge and have been explored in the available literature. It should be noted that comprehensive definitions for these concepts are not extensively provided in either the DSM-5 or the assessment tools. Therefore, additional insights and understanding have been sought through a thorough review of relevant literature. (see table 9).

Intrusive thought	(1) is persistent thought that is associated with distress and accompanied by compulsive rituals, excessive behavioral avoidance, and covert neutralizing strategies (e.g., mental rituals) [11]. (2) Intrusive thought or intrusive image leads to a narrowed focus of attention that, in turn, can impair a person's ability to respond to the external world [12]. (3) Intrusive thought or intrusive image in the context of OCD is associated with great **distress and shame** [12]. (4) Individuals with obsessive–compulsive disorder (OCD) typically experience distressing obsessive thoughts (Rachman, 1997, 1998; Salkovskis, 1985), defined as "recurrent and persistent thoughts, urges, or images that are experienced, at some time during the disturbance, as intrusive and unwanted, and that in most individuals cause marked anxiety or distress" (American Psychiatric Association, 2013, p. 237).
Mental image	a compulsion can take the form of either an overt action observable by others (such as checking that a door is locked) or a covert mental act that cannot be observed (such as repeating a certain phrase in the mind, mental praying) [13] .
Urge	is sensations that drive an individual to perform a behavior [14] [15].
Reassurance behavior	is a compulsive act done in hopes of reducing the anxiety associated with an obsession. [16], [17]. Reassurance seeking in (OCD) has been conceptualized as a form of neutralization behavior. The anxiety of a person is decreased by seeking reassurance, since it reduces the perceived threat, perceived probability of occurrence of a feared event, and perceived responsibility for negative consequences. It is type of compulsion [18].

Table 9:

Based on the previous knowledge, we have identified a total of 118 concepts and 16 relationships between them. Those are illustrated in Table 10 and Table 11.

The object property is listed in table 12.

The data properties are listed in table 13.

Concepts	
(1) OCD	(19) Compulsion
(2) OCRDs	(20) Compulsive behavior
(3) Obsession	(21) Compulsive checking
(4) Intrusive thought	(22) Compulsive counting
(5) Intrusive image	(23) Compulsive ordering
(6) Intrusive urge	(24) Compulsive cleaning
(7) Mental image	(25) Compulsive washing
(8) Thought	(26) Ritual repeating
(9) Urge	(27) Compulsive hoarding
(10) Aggressive obsession	(28) Avoidance behavior
(11) Sexual obsession	(29) Reassurance behavior
(12) Symmetry obsession	(30) Activity
(13)Somatic obsession	(31) Negative emotion
(14) Contamination obsession	(32) Functional impairment (5 ins)
(15) Religious obsession	(33) Risk factor
(16) Hoarding obsession	(34) Childhood adversity factor (4 ins)
(17) Doubt obsession	(35) Demographic factor (9 ins)
(18) Contamination obsession	(36) Environmental factor (7 ins)
(37) Aggressive thought	(38) Sexual thought
(39) Somatic thought	(40) Symmetry thought
(41) hoarding thought	(42) Religious thought
(43) Contamination thought	(45) Doubt thoughts
(46) Morbid thoughts	(47) Aggressive intrusive thought

Table 10: The concepts of OCD, (ins) refer to a concept/class has a number of instance

2 The Natural language statements of identified concepts

This helps to model the logical representation of concepts and evaluate the representation.

Note: there are 50 NL statements for defining 46 concepts. It is important to notice that, the NL definitions were provided for only concepts that were defined as "Equivalent to" other concepts and conditions :

1. **OCD** is an obsession or compulsion or both

2. In OCD, an **Intrusive Thought**, characterising an Obsession, is a Thought that is always associated with negative emotions (e.g. distress).

3. In OCD, an **Intrusive Thought**, characterising an Obsession, tend to frequently occupy a person's mind during her daily life.

4. In OCD, an **Intrusive Thought**, characterising an Obsession, will impact the person's normal activities (e.g. isolation from social circles, inability to work).

5. In OCD, an **Intrusive Mental Image**, characterising an Obsession, is a type of Intrusive Thought that materialises as a visual image in the mind.

6. In OCD, an **Intrusive Urge** or Impulse, characterising an Obsession, is a frequent driving feeling to engage in a distressful behaviour, that affects daily living.

7. In OCD, **Obsession** can be any of: Intrusive Thought, Intrusive Image or Intrusive Impulse/Urge that causes distress due to the added importance that the individual places on them.

8. In OCD, an **Aggressive Obsession** is always an Aggressive Intrusive Thought or an Aggressive Intrusive Image or an Aggressive Intrusive Urge.

9. In OCD, a **Sexual Obsession** is always a Sexual Intrusive Thought or a Sexual Intrusive Image or a Sexual Intrusive Urge.

10. In OCD, a **Somatic Obsession** is always a Somatic Intrusive Thought or a Somatic Intrusive Image or a Somatic Intrusive Urge.

11. In OCD, a **Contamination Obsession** is always a Contamination Intrusive Thought or a Contamination Intrusive Image or a Contamination Intrusive Urge.

12. In OCD, a **Religious Obsession** is always a Religious Intrusive Thought or a Religious Intrusive Image or a Religious Intrusive Urge.

13. In OCD, a **Hoarding Obsession** is always a Hoarding Intrusive Thought or a Hoarding Intrusive Image or a Hoarding Intrusive Urge.

14. In OCD, a **Symmetry Obsession** is always a Symmetry Intrusive Thought or a Symmetry Intrusive Image or a Symmetry Intrusive Urge.

15. In OCD, a **Doubt Obsession** is always a Doubt Intrusive Thought or a Doubt Intrusive Image or a Doubt Intrusive Urge.

16. In OCD, a **Aggressive intrusive thought** is always an Intrusive Thought that of type Aggressive thoughts.

17. In OCD, a **Sexual intrusive thought** is always an Intrusive Thought that of type Sexual thoughts.

18. In OCD, a **Somatic intrusive thought** is always an Intrusive Thought that of type Somatic thoughts.

19. In OCD, a **Contamination intrusive thought** is always an Intrusive Thought that of type Contamination thoughts.

20. In OCD, a **Religious intrusive thought** is always an Intrusive Thought that of type Religious thoughts.

21. In OCD, a **Hoarding intrusive thought** is always an Intrusive Thought that of type Hoarding thoughts.

22. In OCD, a **Symmetry intrusive thought** is always an Intrusive Thought that of type Symmetry thoughts.

23. In OCD, a **Doubt intrusive thought** is always an Intrusive Thought that of type Doubt thoughts.

24. In OCD, a **Aggressive intrusive image** is always an Intrusive Thought that of type Aggressive image.

25. In OCD, a **Sexual intrusive image** is always an Intrusive Thought that of type Sexual image.

26. In OCD, a **Somatic intrusive image** is always an Intrusive Thought that of type Somatic image.

27. In OCD, a **Contamination intrusive image** is always an Intrusive Thought that of type Contamination image.

28. In OCD, a **Religious intrusive image** is always an Intrusive Thought that of type Religious image.

29. In OCD, a **Hoarding intrusive image** is always an Intrusive Thought that of type Hoarding image.

30. In OCD, a **Symmetry intrusive image** is always an Intrusive Thought that of type Symmetry image.

31. In OCD, a **Doubt intrusive image** is always an Intrusive thought that of type Doubt image.

32. In OCD, a **Aggressive intrusive urge** is always an Intrusive urge that of type feeling of aggressive urge.

33. In OCD, a **Sexual intrusive urge** is always an Intrusive urge that of type feeling of sexual urge.

34. In OCD, a **Somatic intrusive urge** is always an Intrusive urge that of type feeling of somatic urge.

35. In OCD, a **Contamination intrusive urge** is always an Intrusive urge that of type feeling of contamination urge.

36. In OCD, a **Religious intrusive urge** is always an Intrusive urge that of type feeling of religious urge.

37. In OCD, a **Hoarding intrusive urge** is always an Intrusive urge that of type feeling of hoarding urge.

38. In OCD, a **Doubt intrusive urge** is always an Intrusive Thought that of type feeling of symmetry urge.

39. In OCD, a **Doubt intrusive urge** is always an Intrusive urge that of type feeling of doubt urge.

40. In OCD, **Compulsions** are some distressing behaviours that are provoked by certain obsessions, that have an impact on daily life and occupy a significant amount of person's time.

41. In OCD, **Compulsions** can take the form of distressing mental activities that a person experiences, in response to certain obsessions.

42. A **compulsion** can be a compulsive physical behavior (checking door) or compulsive mental behavior (mental praying).

43. A **compulsive behavior** is either a compulsive physical behavior or compulsive mental behavior.

44. A **compulsive behavior** is a compulsion.

45. A **Compulsive checking** is a compulsion and checking (checking is an activity).

46. A **Compulsive cleaning** is a compulsion and cleaning (cleaning is an activity).

47. A **Compulsive ordering** is a compulsion and ordering (ordering is an activity).

48. A **Compulsive hoarding** is a compulsion and hoarding (hoarding is an activity).

49. A **Compulsive washing** is a compulsion and washing (washing is an activity).

50. A **Compulsive counting** is a compulsion and counting (counting is an activity).

How the NL statements help us to represent OCD concept

The NL definition of OCD is **an obsession or compulsion or both** . This indicates that OCD can either be obsession or compulsion. In more logical way, an individual of type Obsession is also an individual of type OCD, and an individual of compulsion is an individual of OCD. Figure 2 shows the representation of OCD.
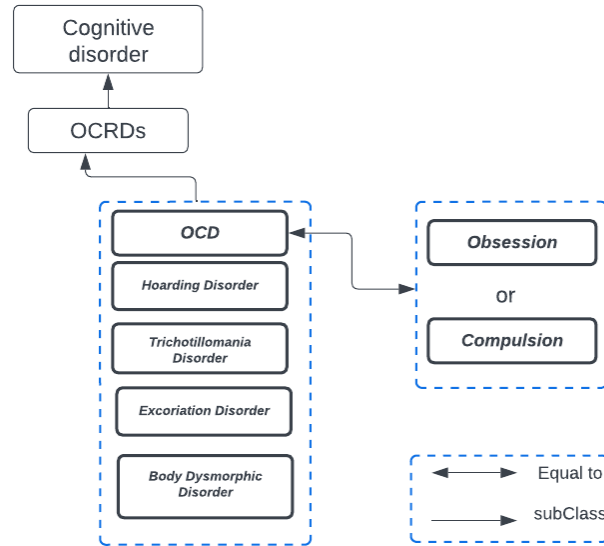

Figure 2: The representation of OCD

The Description logic of OCD (DL).
    (1) OCD $\sqsubseteq$ OCRDs.
(2) OCD $\equiv$ Obsession $\sqcup$ Compulsion.

The NL definition of obsession is an Intrusive Thought, Intrusive Image or Intrusive Impulse/Urge that causes distress due to the added importance that the individual places on them.

This means that an individual of type obsession can be an individual of intrusive thoughts, intrusive image, or intrusive urge associated with type thought appraisal.

Figure 3 shows the representation of Obsession. The sub-classes of obsession are elicited from Y-BOCS.
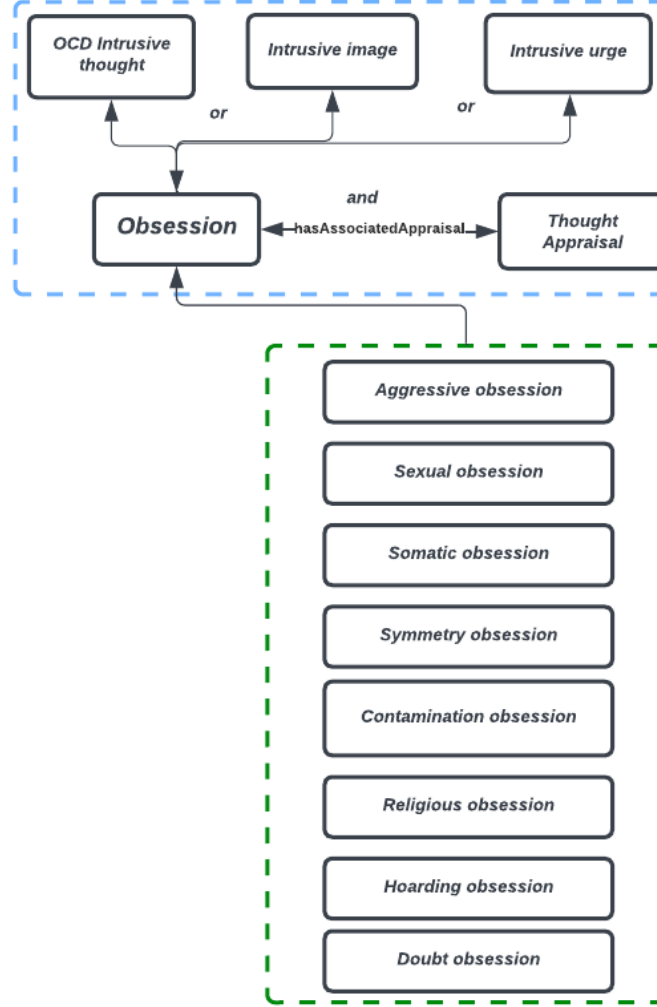
Figure 3: The representation of Obsession

(3) ((Obsession $\equiv$ Intrusive thought $\sqcup$ Intrusive image $\sqcup$ Intrusive urge)
(4) $\sqcap$ ($\exists$ hasAssociatedAppraisal.ThoughtAppraisal))

(5) Aggressive obsession $\sqsubseteq$ Obsession.

(6) Aggressive obsession $\equiv$ Aggressive intrusive thought $\sqcup$ Aggressive intrusive image $\sqcup$ Aggressive obsessive urge.

(7) Hoarding obsession $\sqsubseteq$ Obsession

(8) Hoarding obsession ≡ Hoarding obsessive thought ⊔ Hoarding obsessive image ⊔ Hoarding obsessive urge

(9) Contamination obsession ⊑ Obsession

(10) Contamination obsession ≡ Contamination obsessive thought ⊔ Contamination obsessive image ⊔ Contamination obsessive urge

(11) Sexual obsession ⊑ Obsession

(12) Sexual obsession ≡ Sexual obsessive thought ⊔ Sexual obsessive image ⊔ Sexual obsessive urge

(13) Symmetry obsession ⊑ Obsession

(14) Symmetry obsession ≡ Symmetry obsessive thought ⊔ Symmetry obsessive image ⊔ Symmetry obsessive urge

(15) Somatic obsession ⊑ Obsession

(16) Somatic obsession ≡ Somatic obsessive thought ⊔ Somatic obsessive image ⊔ Somatic obsessive urge

(17) Religious obsession ⊑ Obsession

(18) Religious obsession ≡ Religious obsessive thought ⊔ Religious obsessive image ⊔ Religious obsessive urge

(19) Doubt obsession ⊑ Obsession
(20) Doubt obsession ≡ Doubt obsessive thought ⊔ Doubt obsessive image ⊔ Doubt obsessive urge

Figure 4 shows the representation of Intrusive thought, image and urge. While Figure 5 illustrates the hierarchical representation of "Intrusive thought" , "Intrusive image" and "Intrusive urge".

(21) (Intrusive thought ≡ (Thought ⊓ (∃ hasAssociateEmotion.Emotion)
⊓ (∃ hasAssociateImpairment.FunctionalImpairment)
⊓ (∃ hasAssociateDuration.SeverityDurationLevel))

(22) Intrusive thought ⊑ Thought

(23) Intrusive image ≡ Mental image ⊓ Intrusive thought.

(24) Aggressive intrusive thought ≡ Aggressive thought ⊓ Intrusive thought
(25) Sexual intrusive thought ≡ Sexual thought ⊓ Intrusive thought
(26) Contamination intrusive thought ≡ Contamination thought ⊓ Intrusive thought
(27) Somatic intrusive thought ≡ Somatic thought ⊓ Intrusive thought
(28) Symmetry intrusive thought ≡ Symmetry thought ⊓ Intrusive thought
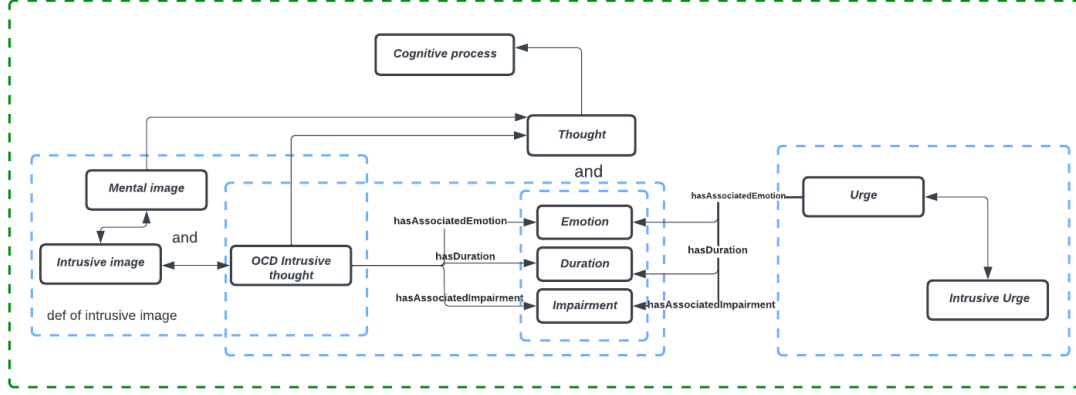(29) Doubt intrusive thought ≡ Doubt thought ⊓ Intrusive thought

Figure 4: The representation of Intrusive thought, image and urge.

(30) Religious intrusive thought $\equiv$ Religious thought $\sqcap$ Intrusive thought

(31) Hoarding intrusive thought $\equiv$ Hoarding thought $\sqcap$ Intrusive thought

(32) (Intrusive urge $\equiv$ (urge $\sqcap$ ($\exists$ hasAssociateEmotion.Emotion)
$\sqcap$ ($\exists$ hasAssociateImpairment.FunctionalImpairment)
$\sqcap$ ($\exists$ hasAssociateDuration.SeverityDurationLevel))

(33) Intrusive urge $\sqsubseteq$ Urge

(34) Aggressive intrusive urge $\equiv$ Feeling of Aggressive urge $\sqcap$ Intrusive thought

(35) Sexual intrusive urge $\equiv$ feeling of Sexual urge $\sqcap$ Intrusive thought

(37) Contamination intrusive urge $\equiv$ feeling of Contamination urge $\sqcap$ Intrusive thought

(38) Somatic intrusive urge $\equiv$ feeling of Somatic urge $\sqcap$ Intrusive thought

(39) Symmetry intrusive urge $\equiv$ feeling of Symmetry urge $\sqcap$ Intrusive thought

(40) Doubt intrusive urge $\equiv$ feeling of Doubt urge $\sqcap$ Intrusive thought

(41) Religious intrusive urge $\equiv$ feeling of Religious urge $\sqcap$ Intrusive thought

(42) Hoarding intrusive urge $\equiv$ feeling of Hoarding urge $\sqcap$ Intrusive thought

The representation of compulsion is illustrated in Figure 6.

(42) Compulsion $\equiv$ Compulsive behavior

(43) Compulsion $\equiv$ (Behavior $\sqcup$ Activity)
$\sqcap$ ($\exists$ hasAssociateEmotion.Emotion)
$\sqcap$ ($\exists$ hasAssociateImpairment.FunctionalImpairment)
$\sqcap$ ($\exists$ hasAssociateDuration.SeverityDurationLevel))

(44) Compulsive behavior $\sqsubseteq$ Behavior

(45) Compulsive behavior $\equiv$ compulsion

(46) Avoidance behavior $\sqsubseteq$ Compulsive behavior

(47) Reassurance behavior $\sqsubseteq$ Compulsive behavior

(48) Physical compulsive behavior $\equiv$ Physical activity $\sqcap$ compulsive behavior

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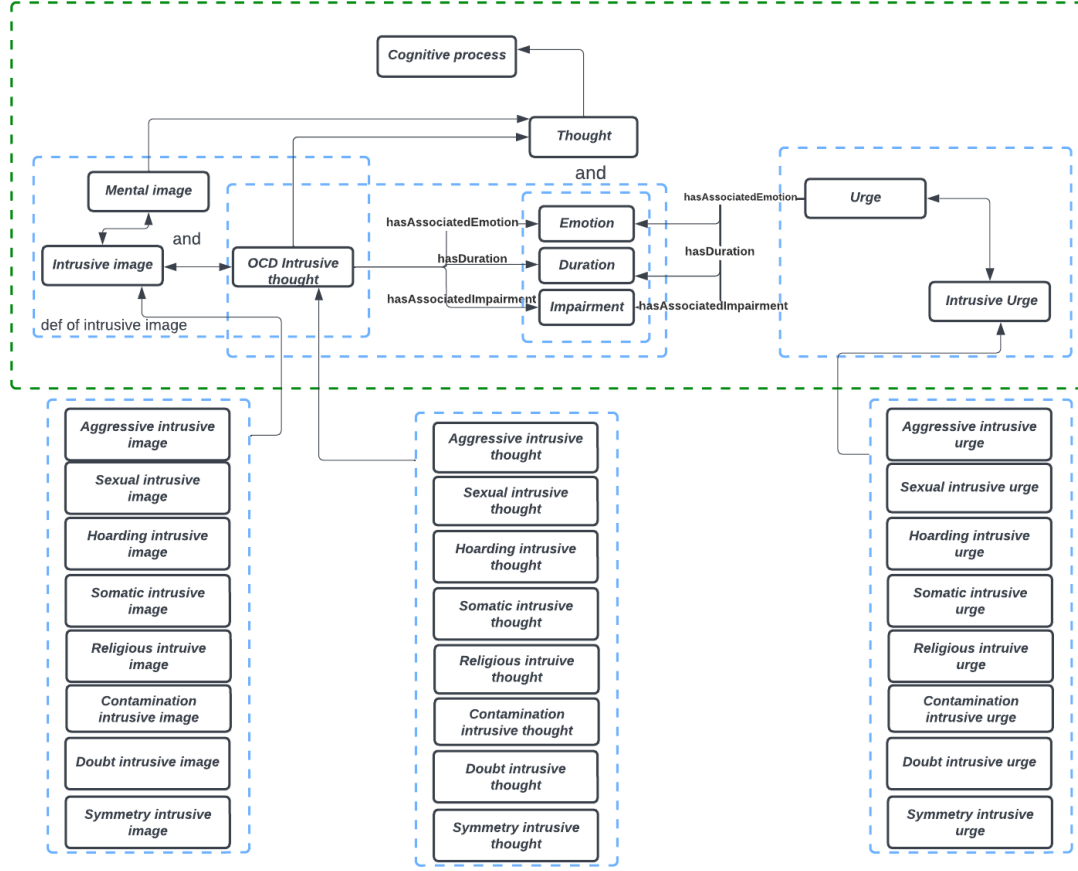
Figure 5: The hierarchical representation of Intrusive thought, image and urge.

(49) Physical activity $\sqsubseteq$ Activity

(50) Mental compulsive behavior $\equiv$ Mental act $\sqcap$ compulsive behavior
(51) Mental act $\sqsubseteq$ Activity (ALC)
(52) Compulsive checking $\equiv$ Checking $\sqcap$ Compulsive behavior

The sub-classes/categories of compulsive behavior are elicited form Y-BOCS and shown in Figure 7. Each type of compulsive behavior is modeled as the following :
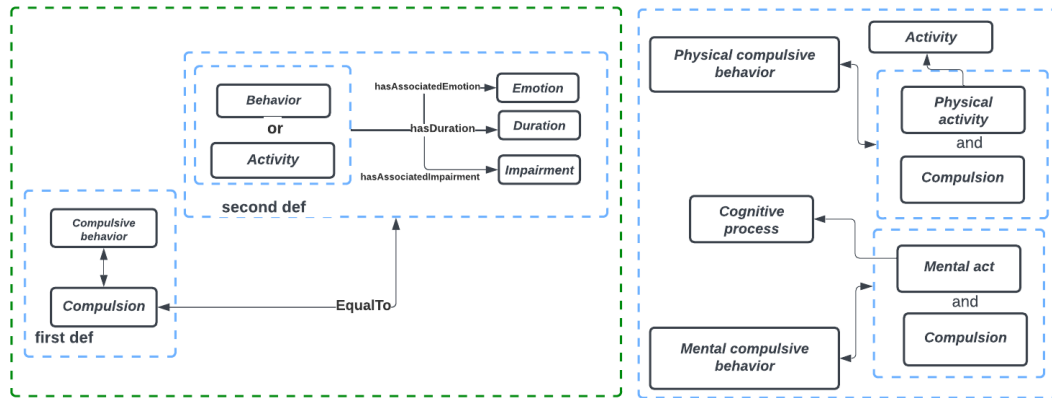
Figure 6: The representaion of compulsion.

3 The re-using of OCD knowledge from existing ontologies
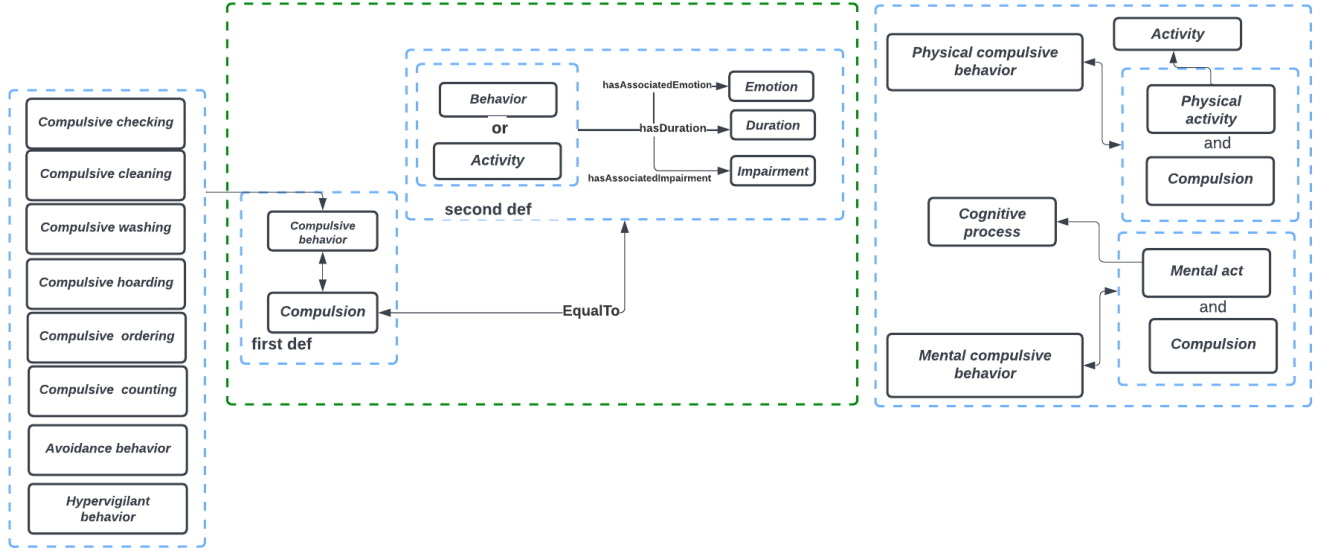
Figure 7: The sub-classes of compulsive behavior

Reusing Existing Ontologies

Related ontologies were identified by searching the NCBO BioPortal [1]; a comprehensive repository of biomedical ontologies. For every concept defined in the previous/analysis phase, corresponding concepts were identified in the existing ontologies. The following heuristics were employed in the decision to reuse concepts.

1. The external concept is considered to be fully equivalent to the required OCD concept, if there is a complete overlap between the logical definitions of the two. In this case, the concept is imported directly to the ontology. When a concept is imported, all its related concepts, including its inheritance tree hierarchy, are also imported. For example, the *Activity* and *Symptom* classes are root classes in the Activity of Daily Living (ADL) ontology [19] and Symptom Ontology (SYMP) [20], respectively. Improting both classes in the OCD ontologies implies the use of their complete ontologies as well.

2. The external concept is considered to be partially equivalent to the required OCD concept, if its logical definition can be considered part of the definition of the required concept. For example, "OCD" is defined in the MDO ontology as a subclass of "Compulsive Disorder". No further definition is given in the MDO ontology. This definition is partially sufficient for our ontology and we need to further refine it. Hence, instead of importing the class and redefining it, we align our definition with the external ontology using the OWL:equivalentClass; an example is, ocd:OCD ≡ mfomd:OCD (where "ocd" and "mfomd" are prefixes for the OCD and the Mental Disease Ontology, respectively). This ontology alignment design pattern allows flexibility of ontology specification, whilst also reusing existing resources.

3. The external concept is considered to be nominally similar to the required OCD concept, if there is some overlap between the logical definitions.

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[1]https://bioportal.bioontology.org/

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Re-using with EquivilantTo

The following figure 8 illustrates the classes that defined as Equivalent To other classes from existing ontologies.

There are (14) classes mapped as Equivalent to other classes from different ontology. Table 14 and table 15 illustrates those classes.

There are (8) classes mapped as sub-classes of other classes from different ontology. Table 16 illustrates those classes.

Figure 8: The re-using ontologies. The arrows with two sides refer to Equivalent to, while the arrows with one side refer to sub-class of.

In figure 9, we visually represent the classes existing in SNOMED-CT that correspond to different concepts of OCD. To establish connections between these classes, we employed the use of an annotation property called "seeAlso." By utilizing the "seeAlso" annotation property, we were able to establish links between these classes, enabling a more cohesive understanding of their interdependencies.

References

[1] Paraskevi Mavrogiorgou, Armin Bader, Eggert Stockfleth, and Georg Juckel. Obsessive-compulsive disorder in dermatology. *JDDG: Journal der Deutschen Dermatologischen Gesellschaft*, 13(10):991–999, 2015.

[2] Cheryl S Rubenstein, Margaret Altemus, Teresa A Pigott, Anemarie Hess, and Dennis L Murphy. Symptom overlap between ocd and bulimia nervosa. *Journal of Anxiety Disorders*, 9(1):1–9, 1995.

[3] Shagun Chawla, Rachel E Menzies, and Ross G Menzies. Existential concerns in ocd with aggressive and sexual obsessions. *Journal of Obsessive-Compulsive and Related Disorders*, page 100710, 2022.
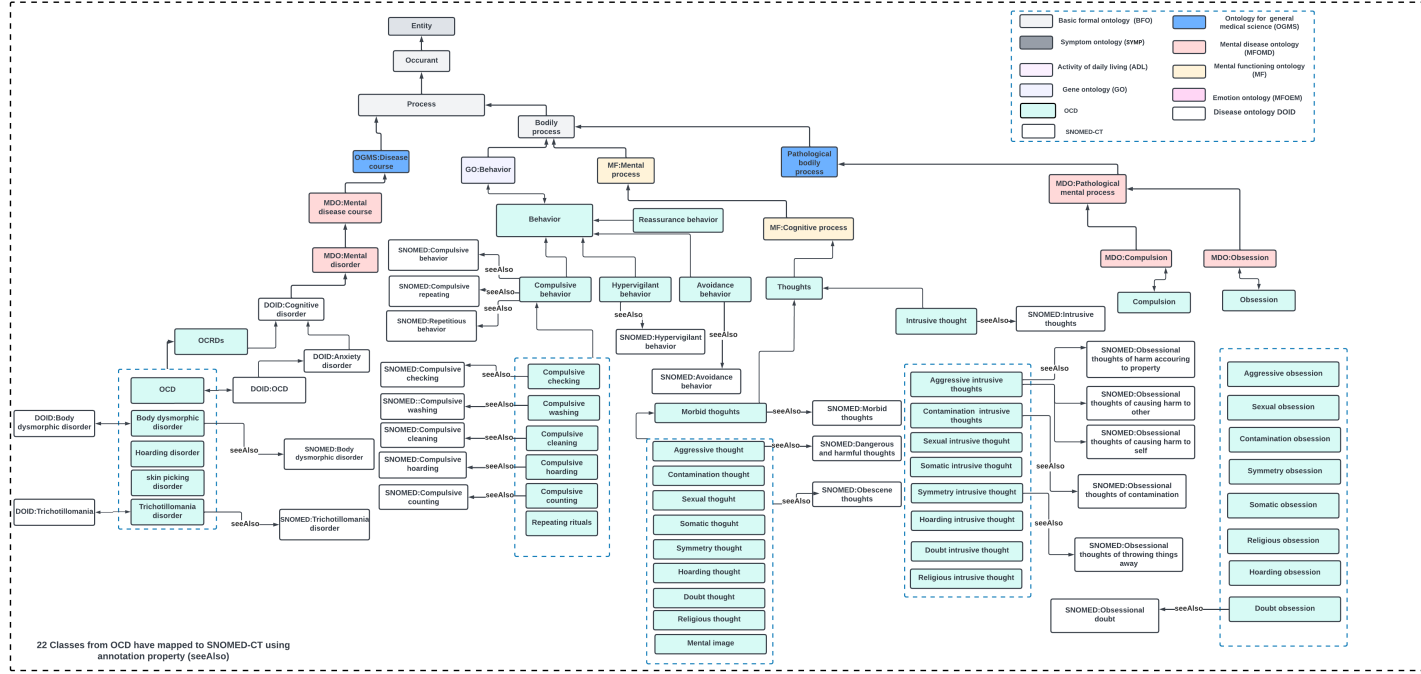
Figure 9: The re-using ontologies. The arrows with two sides refer to Equivalent to, while the arrows with one side refer to sub-class of.

[4] Carol Mathews. Obsessive-compulsive disorders. *CONTINUUM: Lifelong Learning in Neurology*, 27(6):1764–1784, 2021.

[5] Susanne Bejerot, Gunnar Edman, Henrik Anckarsäter, Gunilla Berglund, Christopher Gillberg, Björn Hofvander, Mats B Humble, Ewa Mörtberg, Maria Råstam, Ola Ståhlberg, et al. The brief obsessive–compulsive scale (bocs): A self-report scale for ocd and obsessive–compulsive related disorders. *Nordic journal of psychiatry*, 68(8):549–559, 2014.

[6] S Rachman and Roz Shafran. Cognitive and behavioral features of obsessive–compulsive disorder. 1998.

[7] Paul M Salkovskis, Elizabeth Forrester, and Candida Richards. Cognitive–behavioural approach to understanding obsessional thinking. *The British Journal of Psychiatry*, 173(S35):53–63, 1998.

[8] Obsessive Compulsive Cognitions Working Group et al. Psychometric validation of the obsessive beliefs questionnaire and the interpretation of intrusions inventory: Part i. *Behaviour Research and Therapy*, 41(8):863–878, 2003.

[9] Christine Purdon and David A Clark. The need to control thoughts. In *Cognitive approaches to obsessions and compulsions*, pages 29–43. Elsevier, 2002.

[10] David F Tolin, Carol M Woods, and Jonathan S Abramowitz. Relationship between obsessive beliefs and obsessive–compulsive symptoms. *Cognitive Therapy and Research*, 27(6):657–669, 2003.

[11] Jonathan S Abramowitz, Samantha Meltzer-Brody, Jane Leserman, Susan Killenberg, Katherine Rinaldi, Brittain L Mahaffey, and Cort Pedersen. Obsessional thoughts and compulsive behaviors in a sample of women with postpartum mood symptoms. *Archives of women's mental health*, 13(6):523–530, 2010.

[12] Peter J Lawrence, Michelle G Craske, Claire Kempton, Anne Stewart, and Alan Stein. Intrusive thoughts and images of intentional harm to infants in the context of maternal postnatal depression, anxiety, and ocd. *British Journal of General Practice*, 67(661):376–377, 2017.

[13] David Veale and Alison Roberts. Obsessive-compulsive disorder. *Bmj*, 348:g2183, 2014.

[14] Emily R Stern, Carina Brown, Molly Ludlow, Rebbia Shahab, Katherine Collins, Alexis Lieval, Russell H Tobe, Dan V Iosifescu, Katherine E Burdick, and Lazar Fleysher. The buildup of an urge in obsessive–compulsive disorder: Behavioral and neuroimaging correlates. *Human brain mapping*, 41(6):1611–1625, 2020.

[15] Stephen R Jackson, Amy Parkinson, So Young Kim, Martin Schüermann, and Simon B Eickhoff. On the functional anatomy of the urge-for-action. *Cognitive neuroscience*, 2(3-4):227–243, 2011.

[16] Chris L Parrish and Adam S Radomsky. Why do people seek reassurance and check repeatedly? an investigation of factors involved in compulsive behavior in ocd and depression. *Journal of anxiety disorders*, 24(2):211–222, 2010.

[17] David WS Osborne and Christopher J Williams. Excessive reassurance-seeking. *Advances in psychiatric treatment*, 19(6):420–421, 2013.

[18] Bikem Haciomeroglu. The role of reassurance seeking in obsessive compulsive disorder: the associations between reassurance seeking, dysfunctional beliefs, negative emotions, and obsessive-compulsive symptoms. *BMC psychiatry*, 20(1):1–13, 2020.

[19] Przemysław R Woznowski, Emma L Tonkin, and Peter A Flach. Activities of daily living ontology for ubiquitous systems: Development and evaluation. *Sensors*, 18(7):2361, 2018.

[20] Lynn M Schriml, Cesar Arze, Suvarna Nadendla, Anu Ganapathy, Victor Felix, Anup Mahurkar, Katherine Phillippy, Aaron Gussman, Sam Angiuoli, Elodie Ghedin, et al. Gemina, genomic metadata for infectious agents, a geospatial surveillance pathogen database. *Nucleic acids research*, 38(suppl_1):D754–D764, 2010.

(48) Sexual intrusive thought	(49) Somatic intrusive thought
(50) Symmetry intrusive thought	(51) hoarding intrusive thought
(52) Religious intrusive thought	(53) Contamination intrusive thought
(54) Doubt intrusive thought	(55) Sexual intrusive image
(56) Somatic intrusive image	(57) Symmetry intrusive image
(58) hoarding intrusive image	(59) Religious intrusive image
(60) Contamination intrusive image	(61) Doubt intrusive image
(62) Sexual intrusive urge	(63) Somatic intrusive urge
(64) Symmetry intrusive urge	(65) hoarding intrusive urge
(66) Religious intrusive urge	(67) Contamination intrusive urge
(68) Doubt intrusive thought	(69) Psychiatric Comorbidity factor
(70) Innate Correlate factor (3 ins)	(71) Assessment criteria
(72) Severity control level (9 ins)	(73) Severity distress level (9 ins)
(74) Severity duration level (9 ins)	(75)Severity interference level(9 ins)
(76) Severity resistance level (9 ins)	(77) OCD severity level (4 ins)
(78) Symptom	(79) Treatment
(80) Medication	(81) Phsychological treatment
(82) Mental compulsive behavior	(83) Physical compulsive behavior
(84) Thought appraisal (ins)	(85) Physical activity
(86) Mental praying	(87) Behaviour
(88) Body dysmorphic disorder	(89)Excoriation disorder
(90) Hoarding disorder	(91) Trichotillomania disorder
(92) Stimuli	(93) Hypervigilant behavior
(94) feeling of aggressive urge	(95) feeling of sexual urge
(96) feeling of symmetry urge	(97) feeling of somatic urge
(98) feeling of religious urge	(99) feeling of doubt urge
(100) feeling of contamination urge	(101) feeling of hoarding urge
(102) persistent thoughts	(103)obsessive thoughts
(104)hoarding	(105) washing
(106) cleaning	(107) checking
(108) counting	(109) ordering
(110) Hypervigilant behavior	(111) Social risk factor
(112) Temperamental risk factor	(113) mental calculation
(114) Mental counting	(115) Food
(116) Place	(117)
(118)	

Table 11: The concepts of OCD, (ins) refer to a concept/class has a number of instance

Object property	Domain	Range
(1) hasAssociatedEmotion	Intrusive Thought or Intrusive image or Intrusive urge	Emotion
(2) hasAssociatedImpairment	Intrusive Thought or Intrusive image or Intrusive urge	Functional Impairment
(3) hasAssociatedDuration	Intrusive Thought or Intrusive image or Intrusive urge	Severity duration level
(4) hasAssociatedAppraisal	Intrusive Thought or Intrusive image or Intrusive urge	Thought appraisal
(5) accompaniedBy	Compulsion	Obsession
(6) hasComorbidity	Cognitive disorder	OCRDs
(7) hasControlLevel	Intrusive Thought or Intrusive image or Intrusive urge or Severity level	Severity control level
(8) hasDistressLevel	Intrusive Thought or Intrusive image or Intrusive urge or Severity level	Severity distress level
(9)hasInterferenceLevel	Intrusive Thought or Intrusive image or Intrusive urge or Severity level	Severity interference level
(10) hasResistanceLevel	Intrusive Thought or Intrusive image or Intrusive urge or Severity level	Severity resistance level
(11) hasRiskFactor	OCRDs	Risk factor
(12) hasSeverity	OCD	Severity level
(13) hasStimuli	Intrusive Thought or Intrusive image or Intrusive urge	Room/location or Stimuli
(14) hasSymptom	OCRDs	Symptom
(15) hasTreatmentPlan	OCD or Severity level	Treatment
(16) hasCriteria	Intrusive Thought or Intrusive image or Intrusive urge	Assessment criteria

Table 12: The object property, domain and range.

Object property	Domain	Range
(1) hasControlValue	Severity control level	rdfs:Literal
(2)hasDistressValue	Severity distress level	rdfs:Literal
(3) hasDurationValue	Severity duration level	rdfs:Literal
(4) hasInterferenceValue	Severity interference level	rdfs:Literal
(5)hasResistanceValue	Severity resistance level	rdfs:Literal

Table 13: The data property

Class	re-using ontologies	Reasons
OCD	Disease ontology (DOID)	(1) It provides textual definition that are compatible with the definition of OCD in DSM-5. (2)the class has been re-used and the hierarchical representation of the class has been updated in Mental disease ontology (MDO).
Body dismorphic disorder	Disease ontology (DOID)	(1) It provides textual definition that are compatible with the definition of the class in DSM-5.
Trichotillomania	Disease ontology (DOID)	(1) It provides textual definition that are compatible with the definition of OCD in DSM-5.
Obsession	Mental disease ontology	(1) the Mental Disease Ontology provides textual definitions that align with the definition of obsession as outlined in the DSM-5. (2) the development of the ontology involved a collaborative effort by a group of psychology experts.
Compulsion	Mental disease ontology	(1) the Mental Disease Ontology provides textual definitions that align with the definition of compulsion as outlined in the DSM-5. (2) the development of the ontology involved a collaborative effort by a group of psychology experts. (3) the ontology is an extended modular of mental functioning ontology and Ontology for General medical science (OGMS).
Urge	(feeling of urge) Emotion ontology	(1) the ontology provides textual definitions that align with the definition of urge as outlined in the previous knowledge (table 9).
Negative emotion	(negative emotion) Emotion ontology	
Mental counting	Mental functioning ontology	
Mental calculation	Mental functioning ontology	
Activity	Activity of daily living (ADL)	(1) The ontology provides a comprehensive classes of daily activities.
Place	Activity of daily living (ADL)	(1) The ontology provides a comprehensive classes of daily activities. (2) the "place" class encompasses a diverse range of locations that have the potential to trigger obsessions. These locations are commonly encountered in people's everyday lives.

Table 14: Caption

Class	re-using ontologies	Reasons
Symptom	Symptoms ontology	(1) the ontology provide a wide range of symptoms.
Treatment	Ontology for General Medical Science (OGMS)	
Behavior	Gene Ontology (GO)	

Table 15: The classes of OCD that were defined as Equivalent to other classes in existing ontologies.

Class	alignment ontologies	Reasons
Thought appraisal	sub-class of (appraisal process)/ Emotion ontology	(1) the ontology provide class appraisal process which represents "a mental process that gives rise to an appraisal" .
Thought	sub-class of (cognitive process) /Mental functioning ontology	The representation is based on the definition of cognitive process in the ontology as " mental activities associated with thinking, learning, and memory".
Mental praying	sub-class of (cognitive process) /Mental functioning ontology	Since there are two classes in the ontology , namely mental calculation and mental counting that are represented as sub-class of cognitive process, we mapped mental praying as a sub-class of cognitive process.
Severity level	(process) BFO	(1) Both severity and process can exhibit a dynamic nature. Severity can change over time or vary across different instances of a process. Similarly, processes often involve a progression or sequence of events, making them dynamic entities. Aligning severity with process acknowledges this dynamic aspect and allows for modeling their temporal or evolving nature. (2) Ontologies such as Ontology of Adverse Events (OAE) aligned severity class to "BFO:procee".
Functional impairment	(quality) BFO	(1) BFO:quality serves as a widely adopted top-level ontology for representing quality-related concepts.
Risk factor	(quality) BFO	(1) BFO:quality serves as a widely adopted top-level ontology for representing quality-related concepts.
Assessment criteria	(quality) BFO	(1) BFO:quality serves as a widely adopted top-level ontology for representing quality-related concepts.
trigger	(object) BFO	BFO:object .
symptoms	BFO	BFO:process serves as a widely adopted top-level ontology for representing symptoms-related concepts such as in (OGMS/GO).

Table 16: The classes of OCD that were defined as sub-class of existing classes