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ICF Linking of Patient-Reported Therapy Goals for Children with Acquired Upper Extremity Impairment

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Introduction

In hand therapy practice, patient-reported outcome measurement scales (PROMs) are used routinely for assessing patients' functional and quality of life outcomes.[1] The Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH)[2] and other upper extremity region-specific PROMs, such as the Patient-Rated Wrist Evaluation (PRWE)[3], are well-established PROMs in the adult population[1]. Yet, evidence of well-established PROMs for children and adolescents receiving hand therapy is lacking. In fact, PROMs used in pediatric studies, such as the Pediatric Outcomes Data Collection Instrument (PODCI) and quickDASH, are clinician derived[4, 5] and were initially developed for other populations.[6]

An additional limitation among these PROMs in children is a ceiling effect[7, 8], which occurs when a high proportion of subjects achieve the highest possible score on an outcome measure, making discrimination between subjects at the top end of the scale impossible. Indeed clinically, we have found that children report continued functional deficits when they have attained the maximum score on a PROM such as the PODCI, limiting the clinical utility of such PROMs in guiding ongoing care. Conversely, the Canadian Occupational Performance Measure (COPM)[9], a PROM that derives and measures progress towards patient-identified goals for therapy, has less of a ceiling effect.[8] It is plausible that the COPM's ceiling effect is less in this patient population because the PROM measures patient-identified goals unique to individual patients rather than a set item bank of questions.

Thus, it is possible that the current PROMs are limited because they are not measuring the outcomes that are most relevant to children and adolescents. Therefore, we must determine

what outcomes the pediatric population desires. Historical data of patient identified goals, such as those elicited with the COPM, can be used to obtain qualitative data specific to the population's desired treatment outcomes.

To systematically evaluate patient-reported treatment goals in a given population, it is helpful to utilize an established framework, such as the International Classification of Function, Disability and Health (ICF). This framework has been used in a prior study of adults with shoulder pathology to identify the population's primary functional limitations.[10] The ICF framework, a taxonomy of over 1,400 categories of function, is grouped into the following domains: *b body functions, d activities and participation, e environmental factors and s body structures.*[11] It provides an organizational structure that allows uniformity across medical disciplines.[12] Thus a systematic process of evaluating PROMs, referred to as ICF linking, has been developed and refined.[13-15] With ICF linking, the constructs within the item banks of PROMs are referred to as meaningful concepts.[15] Once identified, the meaningful concepts are then linked to the ICF taxonomy (Figure 1). Studies that use patient-derived data for ICF linking assign meaningful concepts to the patient's reported functional limitations.[10] Drawing on this approach, we applied ICF linking to COPM goals to determine what treatment outcomes are most desired among children and adolescents receiving hand therapy, using a subset of patients with acquired upper extremity impairments.

Study Objective

The objective of this ICF-linking study was two-fold. First, we aimed to identify what outcomes are the most frequently reported as treatment goals on the COPM among children

participating in hand therapy for acquired hand impairment. Additionally, we identified how these priorities align with the domains of the ICF framework.

Methods

The Instrument

The COPM is an outcome measure administered through a semi-structured interview that facilitates identification of one to five patient-derived goals for therapy intervention.[9] Patients rate their perceived performance and their satisfaction for each goal to derive performance and satisfaction scores. The measure is utilized at the initiation of therapy services to generate the patient-derived goals and baseline scores. Reassessment during a therapy episode yields a measure of change in performance and satisfaction towards the patient-derived goals. In the current study, the COPM goals derived at the initiation of treatment reflected the outcomes that the patients desired at the completion of the therapy episode reflecting their priorities for return to premorbid functional abilities. The COPM goals were obtained from interview with the patients during their therapy appointment. Routinely, it is clinical practice in our facility to obtain the goals stated by the child allowing for parent participation when the child looks to the parent to assist them in identifying their treatment goals.

The COPM has established responsiveness and content validity for all ages and the broad range of conditions encompassing occupational therapy practice.[16] Inter-rater reliability of the COPM is moderate[17, 18]. Construct validity of the COPM has also been established[19], and it has been validated as an outcome measurement tool for children with disabilities[18] and in the adult

hand therapy population.[20] In the pediatric population, the COPM was found to identify functional limitations and client-reported goals for therapy that are not measured in current standardized assessments.[18] In adults with acquired upper extremity impairment, improvements in COPM scores correlated with changes in the patients' scores on the Disabilities of the Arm, Shoulder and Hand (DASH).[20] Yet, Case-Smith[20] did not compare the specific functional limitations identified with the COPM directly with the item-bank content of the DASH.[20] Thus, there is limited evidence even within an adult hand therapy population as to the alignment of current PROMS with patients' desired treatment outcomes.

Subjects

The [redacted] Institutional Review Board approved this retrospective chart review for children receiving hand therapy services for acquired upper extremity impairments between January 2014 and December 2018. One-hundred and fifty-one subjects met the following inclusion criteria: 1. Subject were 6 to 18 years old at the initiation of therapy, 2. The upper extremity impairment was acquired, 3. The condition was affecting the elbow, forearm, wrist, or hand, and 4. COPM goals were documented at the initiation of therapy intervention. Subjects were not included if the subject's upper extremity impairment was a congenital hand condition or resulting from a central nervous system disorder, such as hemiplegic cerebral palsy. The demographic characteristics of the 151 children included in this study are outlined in Table 1.

Procedure

In the present study, meaningful concepts were identified within the patient identified COPM goals and linked to the ICF. To accomplish this, two researchers, an occupational therapist certified as a hand therapist (OT-CHT) and a pediatric hand surgeon (MD), who performed the ICF linking in this study reviewed all relevant ICF linking literature[13-15, 21, 22] and met with our third researcher who has expertise in ICF linking[21] to achieve consistent familiarization with the ICF linking process. Then, an alternate set of 55 goals derived from 15 patients with acquired upper extremity impairment that did not fall within the study inclusion parameters were used to derive inter-rater agreement with the ICF linking process. Before analysis of the study set, the two raters independently applied the ICF linking rules[10-12] to the set of 55 goals used for developing inter-rater agreement. The OT-CHT, MD and a researcher who is a physical therapist and athletic trainer (PT/AT) with prior ICF linking experience met to bring consensus to the linked codes for this test set. From this process the research team derived additional linking rules for the study population. The team-derived linking rules (Table 2) were established to achieve more consistency in linking among the research team.

The research team used an iterative ICF linking methodology. The OT-CHT and MD independently applied established ICF linking rules[10-12] and team identified linking rules (Table 2) to the 151 subjects' COPM goals. After independent linking, the OT-CHT (Rater 1) and MD (Rater 2) met to bring consensus to the meaningful concepts and ICF linking for the entire study set. In establishing inter-rater agreement, we compared both raters' codes and arrived at consensus on which raters' coding to use. The process used to reach consensus in coding is outlined in Table 3. The PT/AT was available as an arbitrator for instances when consensus with

established ICF linking rules[10-12] was not possible between the OT-CHT and MD. However, arbitration was not required during consensus building of the ICF linked study set.

Data Analysis

All de-identified data was entered into Microsoft Excel 2013 for the coding and linking process. Descriptive analysis was performed in Microsoft Excel 2013. Inter-rater agreement was evaluated by calculating the percentage of observed agreement and the proportion of positive agreement in Excel and a Kappa statistic in IBM SPSS Statistics 25.0, respectively. Frequency distributions of the linked ICF codes were derived in SPSS.

Results

Each subject had between one and five goals yielding 501 patient-identified goals that were used in this linking study. The linking process for these 501 patient-identified goals yielded 914 meaningful concepts linked to 99 ICF codes in all four ICF domains. Among these 914 meaningful concepts Rater 1 and Rater 2 had initial agreement in their coding of 666 meaningful concepts. Initially, the raters had disagreement with 248 meaningful concepts. For the goals lacking initial agreement between raters on the assigned meaningful concepts or ICF codes, consensus was reached using the linking rules[13-15] (Table 2). Through consensus building the raters agreed to use Rater 1's coding for 70 meaningful concepts and Rater 2's coding for 85 meaningful concepts. For 93 of the coded meaningful concepts the raters either choose alternate codes or found the meaningful concepts were unable to be linked to the ICF (Table 3). Thus, after consensus the total meaningful concepts for all 501 patient goals was 894. In total, 92

unique ICF codes were linked to these 894 meaningful concepts. The frequencies of the 92 ICF linked codes and meaningful concepts are in Table 4.

With respect to inter-rater agreement, the percentage of observed agreement between the OT-CHT and MD independently linked ICF codes was 0.80 for the study set. The Kappa coefficient was 0.32, indicating a fair level of agreement.[23] However, with the high percentage of observed agreement and low Kappa coefficient, we observed a Kappa paradox. A Kappa paradox is the phenomenon of calculating a low Kappa statistic despite a high level of observed agreement between raters.[24, 25] Thus, the proportion of positive agreement, 0.88, is a more accurate measure for interpreting the inter-rater agreement[24, 26] in the present study.

Figure 2 depicts the distribution of all 894 meaningful concepts among the ICF chapters. Meaningful concepts linked to two chapters in the *b body functions* domain: *b2 Sensory functions and pain* and *b7 Neuromuscular skeletal and movement-related functions*. All chapters of the *d activities and participation* domain were linked to meaningful concepts. Two chapters of *e environmental factors* domain (*e1 Products and technology* and *e3 Support and relationships)* and only one chapter (*s7 Structures related to movement*) of the *s body structures* domain were represented in the data.

Twenty-three ICF codes (highlighted in gray in Table 4) comprise the top 77.2% of the most frequently linked codes. Figure 3 displays the distribution of these top 23 codes among the ICF chapters. The greatest percentage (51.4%) of these top codes are within the *d4 Mobility chapter* (Figure 4). These codes in the *d4 Mobility chapter* all represent some aspect of upper extremity use ranging from the broad concept of *d445 Hand and arm* use to six specific

functional patterns of upper extremity use (*d4401 Grasping, d4453 Turning or twisting the hand or arms, d4402 Manipulating, d4451 Pushing, d4455 Catching, and d4458_Weightbearing*). The second largest proportion (14.2%) of linked codes are within the *d9 Community, society, and civic life* chapter (Figure 5). Children expressed goals of returning to participation in a wide array of sports which is reflected in *d9201 Sports*, accounting for the largest proportion (74.8%) of the d9 chapter. Goals of improved function playing instruments, dancing, or participating in creative arts are represented in the 18.1% of d9 codes falling within *d9202 Arts and culture* and goals specific to participation in *play (d9200)* account for 7.1% of the d9 codes. The other codes in the *d Activities and participation* domain that fell within this subset of most frequently linked codes were in the *d5 Self-care* (Figure 6), the *d1 Learning and applying knowledge* and *d3 Communication* chapters. The distribution of codes within the *d5 Self-care chapter* was spread between *d5202 Caring for hair* (34.5%), *d5701 Managing fitness* (34.5%) and *d560 Drinking* (30.9%). *Writing* (*d170*), with a frequency of 4.7% of the top codes, was the only code in the d1 chapter, and *d3601 Using writing machines* (1.0%) the one code from the d3 chapter within this set of 23 codes.

The top 23 most frequently linked codes also included codes from within two chapters of the *b body functions* domain (*b2 Sensory functions and pain* and *b7 Neuromusculoskeletal and movement-related function*) and one chapter of the *s body structures* (*s7 Structures related to movement*). *Pain in the upper limb* (*b28014*) was the only code in the *b2 Sensory functions and pain* chapter representing 11.2% of these top 23 codes. The two codes in *the b7 Neuromusculoskeletal and movement-related functions* chapter accounting for 8.8% of the top 23 codes were *b710 Mobility of joint functions* (pertaining to joint range of motion) and *b7300*

Power of isolated muscles and muscle groups (reflecting strength). The *s7 Structures related to movement* chapter codes, 4.9% of this subset of most frequently linked codes, were *s73011 Wrist joint* and *s7302 Structures of the hand*.

Discussion

Prior studies have established that children can effectively identify relevant goals for therapy, yet disparity was found between the caregiver and the child's treatment priorities.[27] Furthermore, the COPM previously has been found to have less of a ceiling effect than the PODCI[8] suggesting children's treatment priorities for hand therapy may not be adequately represented in the item banks of currently used PROMs. Thus, in the current study our aim was to identify the most desired treatment outcomes among children receiving therapy services for acquired upper extremity impairment. To do so, we identified the meaningful concepts in the study population's COPM goals and linked the meaningful concepts to corresponding ICF codes. While the entire study population desired treatment outcomes linked to 92 unique ICF codes, twenty-three ICF codes correspond to the most frequently identified meaningful concepts in patient-identified goals for therapy outcomes and accounted for 77.2% of the desired outcomes. This finding of a diverse array of meaningful concepts within a population's self-identified goals narrowing into a concentration of the most commonly represented meaningful concepts aligning with a more defined group of ICF codes is similar to ICF linking study of patient desired functional outcomes for patients with shoulder pathology.[21] Thus, suggesting a commonality

exists among the most frequently identified outcomes that populations desire for therapy intervention even when taking into account variation among individuals within the population.

When considering the twenty-three most frequently desired outcomes, the prevalence of *d4 Mobility* codes (51.4%) is not surprising since the study population was receiving therapy to address upper extremity impairments. The codes in this chapter all reflect various aspects of hand and arm use ranging from the comprehensive concept of *d445 Hand and arm use* to more refined level three ICF codes (Figure 1) that reflect specific upper extremity movements, such as grasp and manipulation. This finding is consistent with the finding that goals pertaining to upper limb function were the greatest percentage of treatment priorities identified with Goal Attainment Scaling in a population of children with cerebral palsy participating in therapy.[28] Similarly, because our population reflects school-aged children, the prevalence of goals specific to improvements with writing and typing (coded as *d3601 Using writing machines*) skills also aligns with expected occupational priorities for this age range.[27] Missiuna and Pollock (2000)[27] found that children prioritized writing skills as a top priority for their therapy goals.

Similar to studies in other pediatric populations,[27] these data highlight the importance this population places on participation in the occupations of sports, music and performing arts, and play. All of these activities are reflected in the *d9 Community, society and civic life* chapter which accounts for the second largest proportion (14.2%) of codes in the top 23 codes. Furthermore, the code *d5701 Managing fitness* (Figure 6) was linked to the patient goals that include the concepts of “weightlifting” and performing “push-ups”. Thus, our findings suggest

that PROMs used for this population should measure outcomes specific to performance in sports and fitness, music and performing arts, and play.

Some patient-derived goals could not be classified in specific ICF codes, requiring more general codes to be used. For instance, the *d445 Hand and arm use* code was employed when the stated goal reflected a dimension of hand and arm that was not adequately reflected by the more refined level three ICF codes. For example, "dribble a basketball" or "serve a volleyball" was linked to "sports" and "hand and arm use" as the definitions of the level three ICF codes (Figure 1) in the *d4 Mobility* chapter did not reflect dribbling or serving a ball. This phenomenon suggests that PROMs questioning specific task performance may overlook the specific tasks that matter to patients. For instance, traditional activity-specific functions such as "put on a coat" found in the Upper Extremity Function Scale of the PODCI or "use a key to unlock a door" in the PROMIS Upper Extremity Function Computer Adapted Test (CAT) were not goals in this study. Further study is necessary to evaluate whether or not using item banks with broader concepts of upper extremity use for patients to rate their functional performance on a PROM would limit the ceiling effect found when using PROMs such as the PODCI Upper Extremity Function scale with this population[8].

Furthermore, it is unknown if the PROMs currently used in studies evaluating functional outcomes for children and adolescents with acquired upper extremity impairment include all the dimensions of upper extremity function reflected in these data. Recent studies evaluating treatment outcomes in this population have employed the QuickDASH[29-36], the DASH[37, 38], the Pediatric Patient-Reported Outcomes Measurement Information Systems (PROMIS) scales[39, 40], and the Pediatric Outcomes Data Collections Instrument (PODCI).[33, 41, 42] Yet, how item banks of

these validated PROMs align to what children are reporting as desired treatment outcomes has not been explored. Gaps may exist between the functional outcomes desired by this population and the functional outcomes being measured with current PROMs. For example, with respect to participation in *d9 Community, society, and civic life* (Figure 5) these data reflect that participation in occupations such as dance and playing musical instruments, represented by the *d9202 Arts and culture* code, are occupations of greatest importance to this population. Of these four PROMs, only the "Optional Sports and Performing Arts" of the DASH and quickDASH includes questions about participation in performing arts. In the recent studies evaluating functional outcomes within pediatric populations, only one[36] out of the ten that used the quickDASH[29-36] or DASH[37, 38] employed this optional module. With respect to the occupations aligned with self-care (Figure 6), all three PROMs include items that correspond to some aspect of dressing, which was not found among the study population's top self-care concerns. Additionally, bearing weight through the upper extremity (*d 4458_Weight bearing*) was within the cohort's top 23 codes, yet no items on the PODCI or PROMIS upper extremity scales reflect this task demand. One item on the QuickDASH does address the ability to participate in activities that "require the ability to take some impact or force" through the upper extremity. A more systematic comparison of study findings with current PROMs is necessary to accurately evaluate alignment of current PROMs with the outcomes desired by this population. Additionally, an opportunity remains to compare study findings to the ICF comprehensive and brief hand core sets.[43, 44] Whereas Vincent et al. (2015)[45] linked the item banks of two PROMs to the ICF coresets, both of which were derived from the perspective of healthcare professionals,[43, 44, 46, 47] the current work draws on patient-derived treatment outcomes. Thus, future work

comparing study findings to the ICF hand coresets would add a perspective of alignment between the ICF hand coresets and patient-desired treatment outcomes.

When considering the 23 most frequently desired outcomes, these data do support that children have goals for improvement in range of motion *(b710 Mobility of a joint functions)* and strength (*b7300 Power of isolated muscles and muscle groups),* and reduction in pain (*b28019 Pain in the upper limb*). Therefore, traditional measures of body functions, such as range of motion and strength measurements and pain scale measures, have value in measuring changes towards the outcomes the pediatric population desires with respect to the b *body functions* domain.

Less than 1% of all codes (0.8% in d7 "Interpersonal interactions and relationships" and 0.1% in e3 "Support and relationships") are specific to interpersonal relationships. Prior studies have employed using scales such as the PODCI Happiness subscale[33, 41] and the PROMIS Pediatric Peer Relationships CAT[39, 40] to evaluate outcomes with similar patient populations. Additional study is necessary to explore the relevance of assessing outcomes specific to psychosocial factors in this population. It is possible that the nature of the patient interviews for obtaining COPM goals did not elucidate concerns specific to psychosocial function within this cohort.

The strong agreement by the OT-CHT and MD who performed the ICF linking was likely derived from the study methodology. Applying the linking rules to a test set of data[21] allowed refinement of the rules for this study likely yielding the high inter-rater agreement for linking the study set.

Study Limitations

The ICF framework and linking process allowed for systematic evaluation of patient desired outcomes for hand therapy intervention in the context of global health. Having data from patient reported goals for treatment allowed for the exploration of outcomes from the patients' perspective. However, when linking some documented goals, the authors were limited by the nature of chart review and using what the therapists documented as the patient stated goals. We were unable to gain greater specificity than what was reported in the medical record. Therefore, for goals such as "perform a cartwheel" we could not infer what component of the activity was underlying the impairment in participation. Because numerous factors, such as pain, range of motion limitations, and weakness, could be making participation in the activity difficult but were not recorded in the chart, we had to use less specific codes (e.g., *d789 movement* in our linking process). Consequently, we may have missed meaningful concepts that aligned with the client concerns but were not recorded.

For some concepts derived from the patient-stated goals, the ICF had a level of specificity that prevented us from using certain codes. For example, the concept of "endurance" was expressed by patients in the context of being able to sustain participation in an activity (e.g., "Throw a ball for 20-30 minutes"). The ICF codes for endurance were either specific to muscle endurance falling within the *b7* Neuromusculoskeletal and movement-related functions or within *b4 Functions of the cardiovascular, hematological, immunological, and respiratory systems*. These codes, indicating either muscle endurance functions or cardiovascular and respiratory endurance, were a level of specificity beyond what we could ascertain from the stated goal. In

such cases, we applied the previously established linking rules[14] and used an "other-specified" code.

The population in this study includes a wide range of children and adolescents, from 6-18 years old, at differing developmental stages. Additionally, the diagnoses represented in this study population encompass the elbow, wrist and hand and range from nonspecific pain to specific acute injuries (e.g., flexor tendon lacerations and fractures). While the study population's heterogeneity could be considered as a limitation, it reflects the breadth of age ranges and diagnoses that comprise a pediatric hand therapy practice. Therefore, study population's heterogeneity enhances the generalizability of the study findings to the defined population.

Conclusions

The study results highlight that the ICF domain of *Activities and participation* is the greatest global health concern in this population. Specifically, children and adolescents participating in hand therapy for acquired upper extremity impairment are reporting top functional priorities in a various dimensions of hand and arm use and in participation in sports and fitness, music and performing arts, and play. These findings suggest there is a need to consider areas of activity participation that may not be measured by current PROMs used with this population. Further research is needed to identify agreement between the outcomes children and adolescents with acquired upper extremity impairment desire and the items measured with current PROMs. Study findings suggest that children and adolescents do value improvement in outcomes that align with current body functions measures, such as measures of pain, range of

motion and strength. Finally, additional research may elucidate whether PROMs need to include measurement of psychosocial factors for this population.

Conflict of Interest

Conflicts of interest: none.

Table 1: Demographics of the study population

Characteristic	*n*
Sex	
Male	61
Female	90
Age	
6-9 years old	13
10-12 years old	29
13-15 years old	61
16-18 years old	49
Diagnostic categories*	
Fractures and dislocations:	
Hand	37
Wrist	18
Forearm	6
Elbow	7
Pain NOS**	
Hand	10
Wrist	33
Soft Tissue Injury***	
Hand	15
Wrist	21
Peripheral Nerve Injury	4

* Four patients had multiple diagnoses, such as a fracture and nerve injury and were included in counts for both categories for which their diagnoses fell within

** Not otherwise specified: includes acute and chronic pain presentations without clinical findings of fracture of soft tissue injury

***Includes ligamentous, tendon, epidermal and TFCC injury

Table 2: Research Team Rules for Linking to ICF Codes

1. Include the upper extremity demand (ex. manipulate) and context (ex. painting) if both are documented in the patient reported goal.
2. Be as specific as possible, but do not infer more that the patient states in their goal.
    a. Unless specified by the patient, avoid inserting specific activities (ex. push/pull/grasp/twist with a goal of “open door”) and/or body functions (ex. joint stability/mobility) even if those activities and functions could be components of the patient’s stated goal.
    b. When a patient describes specific activities (ex. push, pull, grasp, etc.) and/or body functions (ex. joint stability/mobility) in the context of a more general activity, use the respective code for the specific and general activities (ex. for goal “perform a pull up” the codes for pull, fitness and strength are used).
3. If the activity stated in the patient goal does not fit within a specific ICF activity code (d) but involves hand and arm use, then use hand/arm use (d445). The same applies for activities involving fine hand use. With fine hand use when this occurs, use fine hand use (d440).
4. Do not use codes related to the patient’s stated activity if the description of the ICF code differs from the patient’s stated goal (e.g., do not use the exercises tolerance code (b445) for weightlifting because the b445 code is specific to cardiovascular function).
5. If the goal refers to a specific body structure, include the body structure code for that goal in addition to the activity or body function code.

Table 3: Approach to establishing inter-rater agreement for the final list of linked ICF codes.

	Rater 1	
Rater 2	A	B
	C	D

Cell A indicates that Rater 1 and Rater 2 had agreement in their ICF linking of meaningful concepts

Cell B indicates initial disagreement between Rater 1 and Rater 2 in their assigned ICF codes with agreement to use Rater 2's coding

Cell C indicates initial disagreement between Rater 1 and Rater 2 in their assigned ICF codes with agreement to use Rater 1's coding

Cell D indicates that there was no agreement between Rater 1 and Rater 2 in their assigned ICF codes and neither of the initial codes was accepted

Table 4: Frequencies of all 92 ICF Linked Codes

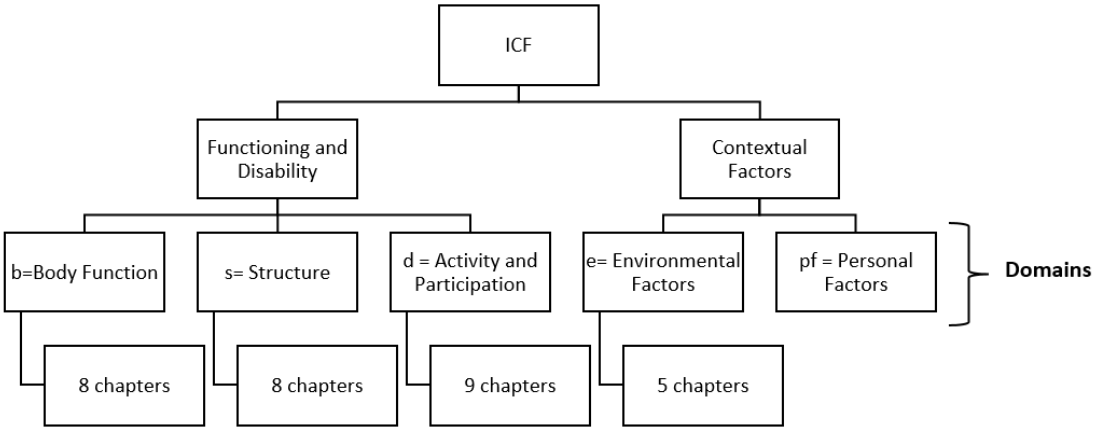
ICF Limitation Description	ICF Code	Frequency	Percent	Cumulative Percent
Pain in upper limb	b28014	100	11.2	11.2
sports	d9201	95	10.6	21.8
hand and arm use	d445	49	5.5	27.3
strength	b7300	46	5.1	32.4
grasping	d4401	45	5.0	37.4
writing	d170	42	4.7	42.1
lifting	d4300	42	4.7	46.8
mobility of joint functions	b710	33	3.7	50.5
wrist	s73011	29	3.2	53.7
arts and culture	d9202	23	2.6	56.3
throwing	d4454	21	2.3	58.7
caring for hair	d5202	19	2.1	60.8
managing fitness	d5701	19	2.1	62.9
turning or twisting the hands or arms	d4453	18	2.0	64.9
drinking	d560	17	1.9	66.8
manipulating	d4402	16	1.8	68.6
structure of the hand	s7302	15	1.7	70.3
carry, unspecified	d4308_carry	14	1.6	71.8
pushing	d4451	12	1.3	73.2
using writing machines	d3601	9	1.0	74.2
catching	d4455	9	1.0	75.2
hand and arm use, unspecified	d4458_weight bear	9	1.0	76.2
play	d9200	9	1.0	77.2
movement functions, other specified	b789	8	0.9	78.1
washing body parts	d5100	8	0.9	79.0
dressing	d540	8	0.9	79.9
putting on clothes	d5400	8	0.9	80.8
maintaining a job	d8451	8	0.9	81.7
structure of the hand, other specified	s73028_finger	8	0.9	82.6
eating	d550	7	0.8	83.4
general products and technology for education	e1300	7	0.8	84.1
putting on footwear	d5402	6	0.7	84.8
school education	d820	6	0.7	85.5

carrying in the hands	d4301	5	0.6	86.0
swimming	d4554	5	0.6	86.6
driving motorized vehicles	d4751	5	0.6	87.2
structure of the upper extremity	s730	5	0.6	87.7
general tasks and demands, unspecified	d228_activity endurance	4	0.4	88.2
producing drawings and photographs	d3352	4	0.4	88.6
fine hand use	d440	4	0.4	89.1
structure of the hand	s7302	4	0.4	89.5
socializing	d9205	4	0.4	89.9
structure of the forearm	s7301	4	0.4	90.4
producing body language	d3350	3	0.3	90.7
pulling	d4450	3	0.3	91.1
driving human powered transportation	d4750	3	0.3	91.4
preparing meals	d630	3	0.3	91.7
taking care of animals	d6506	3	0.3	92.1
education, other specified	d838_class	3	0.3	92.4
recreation and leisure	d920	3	0.3	92.7
muscles of the hand	s73022	3	0.3	93.1
structure of the hand, other specified	s73028_thumb	3	0.3	93.4
touch function	b265	2	0.2	93.6
using telecommunication devices	d3600	2	0.2	93.9
changing basic body position, other specified	d4108_functional transfer	2	0.2	94.1
lifting and carrying objects	d430	2	0.2	94.3
carrying in the arms	d4302	2	0.2	94.5
running	d4552	2	0.2	94.7
washing the whole body	d5101	2	0.2	95.0
caring for skin	d5200	2	0.2	95.2
doing housework	d640	2	0.2	95.4
disposing of garbage	d6405	2	0.2	95.6
food	e1100	2	0.2	95.9
friends	e320	1	0.1	96.0
pain in a body part	b2801	1	0.1	96.1
additional sensory functions, other specified	b279	1	0.1	96.2
caring for teeth	d5201	1	0.1	96.3
mobility of a single joint	b7100	1	0.1	96.4
mobility of joints generalized	b7102	1	0.1	96.5

tone of isolated muscles and muscle groups	b7350	1	0.1	96.6
muscle endurance functions	b740	1	0.1	96.8
control of voluntary movement functions	b760	1	0.1	96.9
sensation of muscle spasm	b7801	1	0.1	97.0
communicating with and receiving written messages	d325	1	0.1	97.1
writing messages	d345	1	0.1	97.2
lying down	d4100	1	0.1	97.3
sitting	d4103	1	0.1	97.4
standing	d4104	1	0.1	97.5
carrying on shoulders, hip and back	d4303	1	0.1	97.7
picking up	d4400	1	0.1	97.8
reaching	d4452	1	0.1	97.9
walking	d450	1	0.1	98.0
climbing	d4551	1	0.1	98.1
jumping	d4553	1	0.1	98.2
using private motorized transportation	d4701	1	0.1	98.3
using transportation, other specified	d4708	1	0.1	98.4
caring for teeth	d5201	1	0.1	98.5
toileting	d530	1	0.1	98.7
maintaining one's health	d5702	1	0.1	98.8
cleaning the living area	d6402	1	0.1	98.9
assisting others with movement	d6601	1	0.1	99.0
basic interpersonal skills	d710	1	0.1	99.1
muscles of the hand	s73022	1	0.1	99.2
sibling relationships	d7602	1	0.1	99.3
general products and technology for personal use	e1150	1	0.1	99.4
general products and technology for communication	e1250	1	0.1	99.6
structure of the hand	s7032	1	0.1	99.7
elbow joint	s73001	1	0.1	99.8
muscles of the upper arm	s73002	1	0.1	99.9
	Total	894	100.0	

Note: The codes highlighted in light gray represent the top 23 codes (77.2%).

Figure 1: Taxonomy of the ICF.



Each of the above chapters is further detailed into categories. These categories become more detailed as they unfold into 2nd level, 3rd level and 4th level categories. The level of the category is indicated by the code itself. The code breaks apart as follows:

b28014, where b= domain, 2 = chapter (level 1), 80 = level 2, 1 = level 3, 4= level 4

Figure 2: Cumulative percentage of linked codes by chapter for the complete 894 meaningful concepts

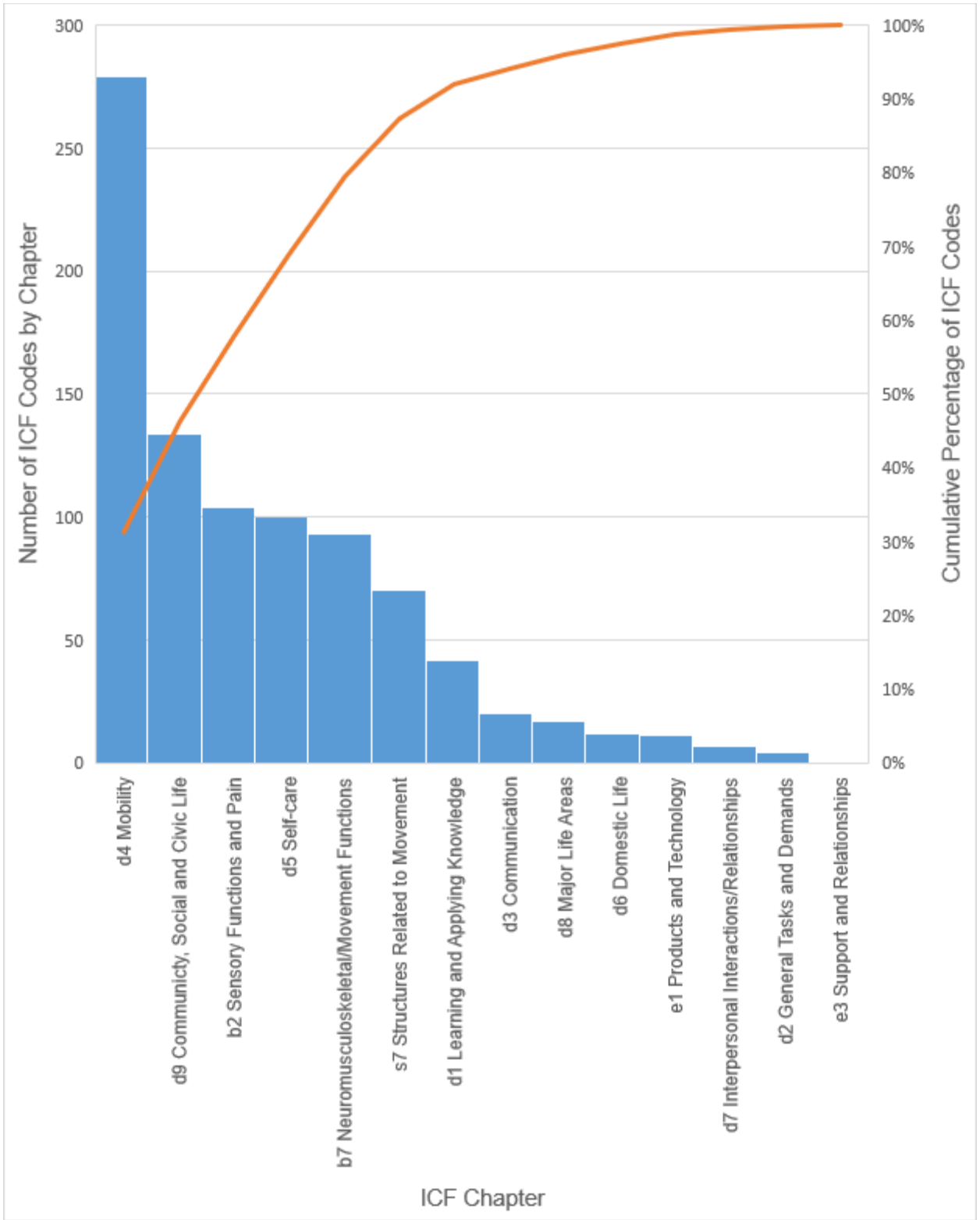

Number of ICF Codes by Chapter
Cumulative Percentage of ICF Codes
ICF Chapter
300
250
200
150
100
50
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
d4 Mobility
d9 Communicty, Social and Civic Life
b2 Sensory Functions and Pain
d5 Self-care
b7 Neuromusculoskeletal/Movement Functions
s7 Structures Related to Movement
d1 Learning and Applying Knowledge
d3 Communication
d8 Major Life Areas
d6 Domestic Life
e1 Products and Technology
d7 Interpersonal Interactions/Relationships
d2 General Tasks and Demands
e3 Support and Relationships

Figure 3: Distribution of the top 77.2% of codes by chapter. This includes all codes that were 1% or greater of the entire set of linked codes

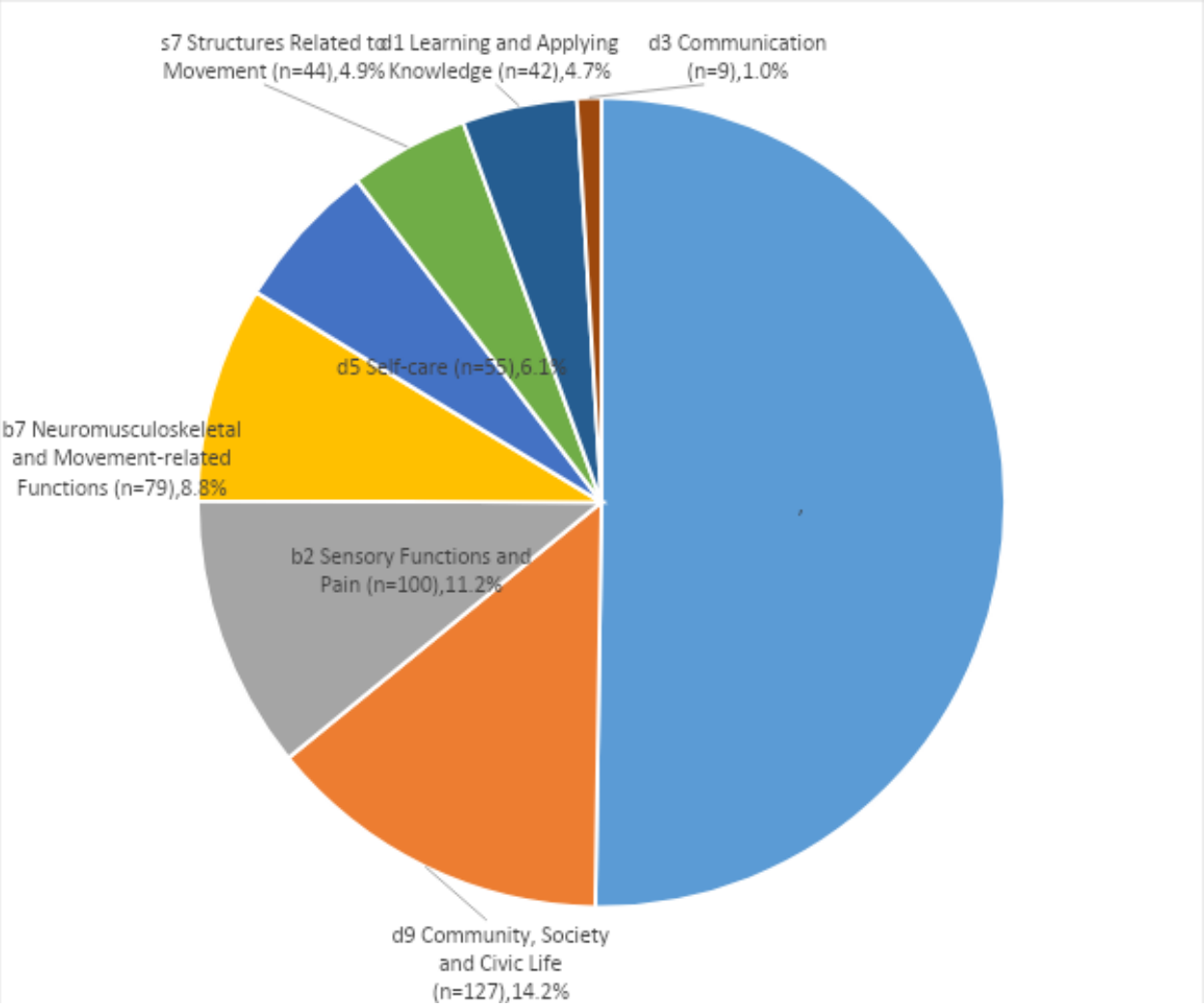


Figure 4: Distribution of the d4 Mobility chapter codes in the top 77.2% of linked codes

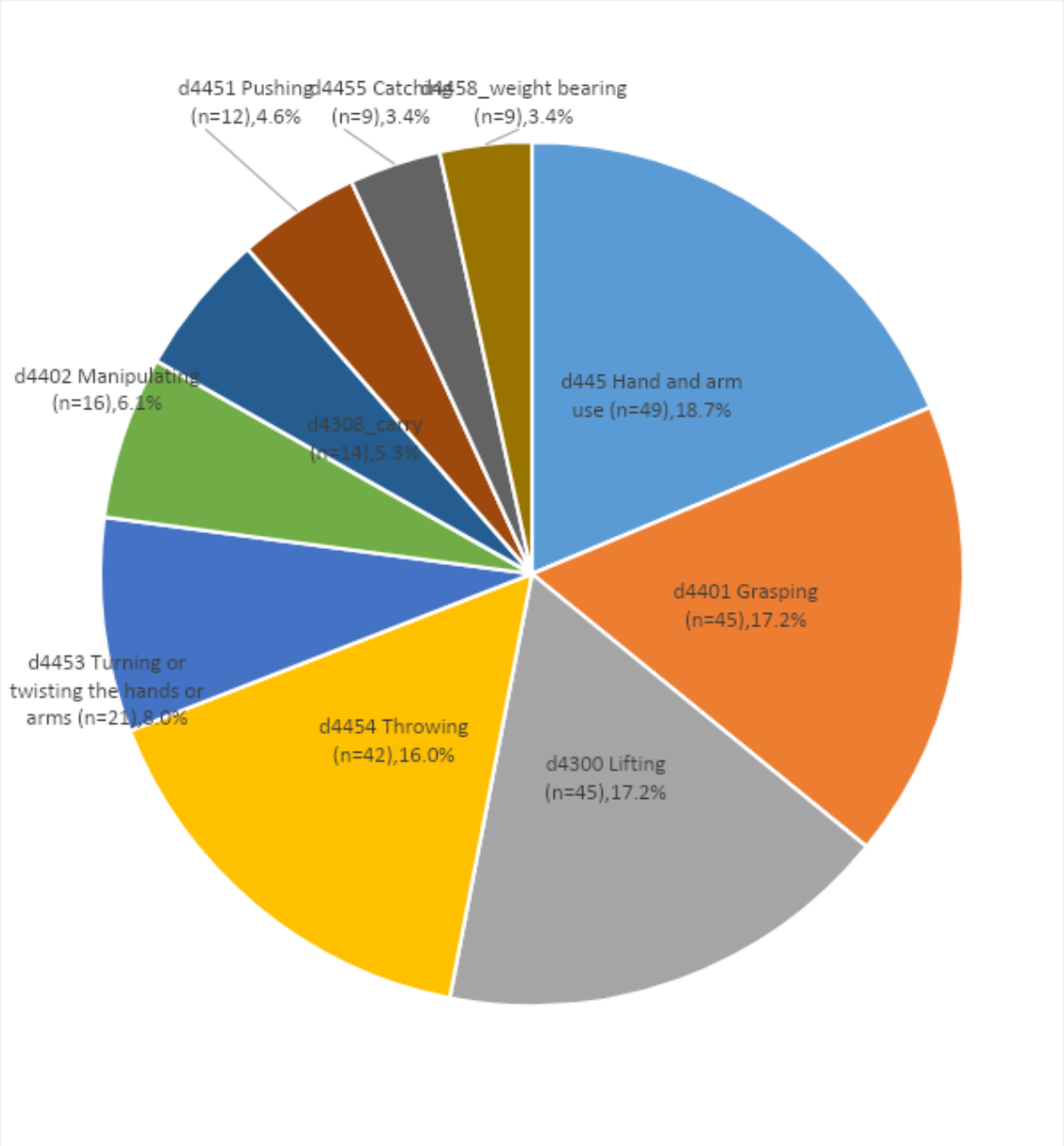


Figure 5: Distribution of the d9 Community, society, and civic life chapter codes in the top 77.2% of linked codes

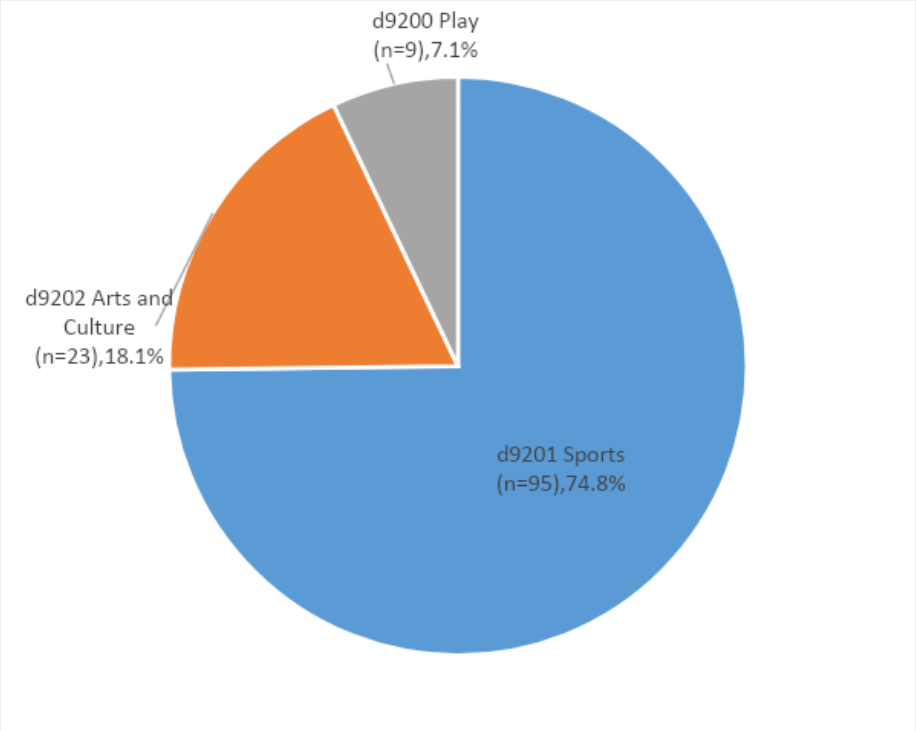
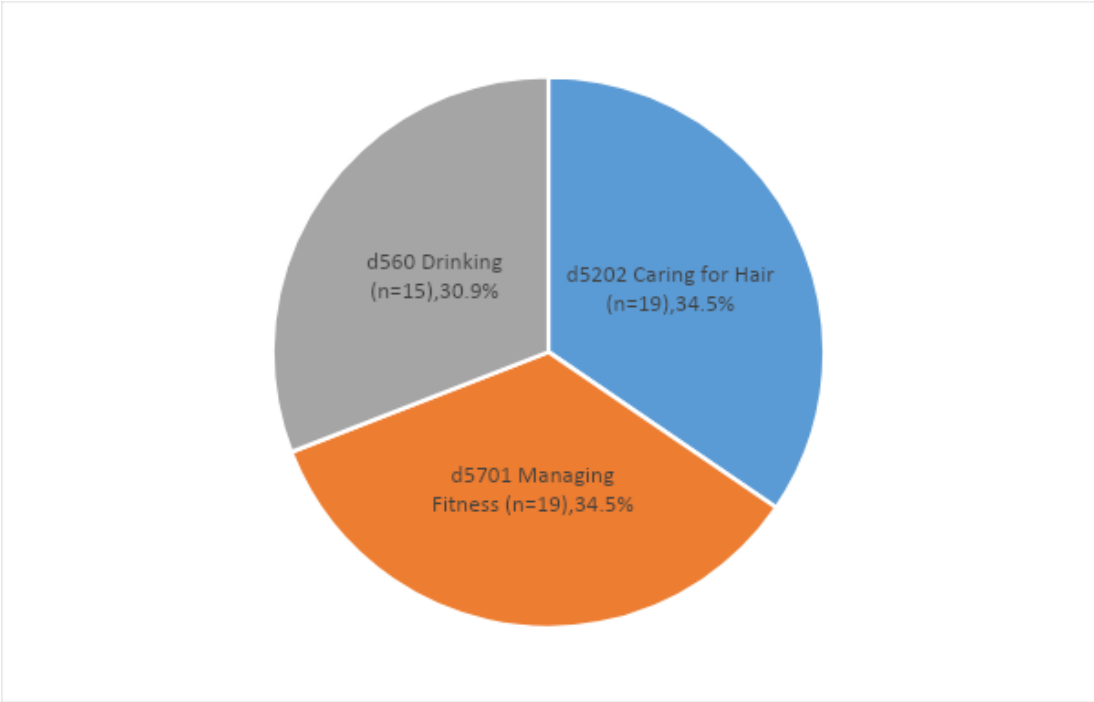


Figure 6: Distribution of the d5 Self-care chapter codes in the top 77.2% of linked codes



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