



## Original Article

# Portable Abdominal Sonographic Findings and Characteristics of Service Users in the Community

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## ABSTRACT

**Background/Purpose:** Home healthcare users and institution residents are thought to receive insufficient medical service due to their inconvenience to visit the hospital. Portable ultrasound (US) may overcome the problem of accessibility, and services can be provided directly in the community. We aimed to report portable US findings and characteristics of service users in the settings of these vulnerable patients.

**Methods:** This was a retrospective epidemiological report of portable US findings in homecare patients and institution residents. Patients in homecare settings and residents of two long-term care institutions affiliated with a community medical center were enrolled. Portable US was performed during regular visits in the community. The participants' medical records were used to retrieve general data, health condition and main diagnoses. Subgroup analysis was performed.

**Results:** The 132 participants included 44 (33.3%) homecare patients and 88 (66.7%) institution residents. The most common findings were fatty liver in 33 (25.0%) cases and gallbladder stones in 30 (22.7%) cases. Compared to institution residents, homecare patients had higher proportion (38.6% vs. 8.0%,  $p < 0.001$ ) of hepatobiliary findings on portable US, mainly liver cirrhosis. The proportion of other findings showed no significant difference between the two groups.

**Conclusion:** Portable US improved the accessibility to medical service of homecare patients and institution residents. Fatty liver and gallstones were the most common problems detected among this vulnerable group. Homecare and institution patients may need portable US due to difficulties in medical accessibility. Further large scale study is warranted.

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## 1. INTRODUCTION

In an aged society, it's a major challenge to follow-up the fluctuating clinical condition of the elderly with disability in the community, whether at home or in the institution. Taiwanese National Health Insurance (NHI) implemented the integrated home care program since April, 2015. Home-bound patients with difficulty in accessing the medical institutions were visited by medical providers. Through this program, the accessibility of medical services as well as unplanned hospitalizations or emergency department visits were expected to improve.

Some medical conditions, such as fatty liver and gallbladder stone, are associated with serious complications in specific patients. Fatty liver can lead to non-alcoholic steato-hepatitis, liver cirrhosis, and eventually hepatocellular carcinoma.<sup>1</sup> Gallstones may be complicated with acute cholecystitis or cholangitis, which can lead to profound infection or sepsis.<sup>2</sup> Further evaluation or treatment may be suggested in patients with certain diagnosis.

Point-of-care ultrasound (POCUS) means ultrasound (US) performed by the provider in real time with portable machines at patient's place. It can be helpful in procedural, diagnostic, and screening purposes. POCUS was considered beneficial for improving the quality of homecare.<sup>3</sup>

However, image-guided examination of the disabled population is underserved in most countries. The median percentage of in-house abdominal US accessibility was only 15.3% in Europe in 2019.<sup>4</sup> Also, US is not routinely performed in homecare visits or in institutions in Taiwan. Data about portable US application in homecare and institutionalized patients are still lacking.

Comparing to the institution residents, we hypothesized that the prevalence of medical conditions may be higher in the institution residents. We aimed to provide epidemiological data about hepatobiliary diseases in these vulnerable groups.

## 2. METHODS

### 2.1. Case Recruitment

This was an epidemiological study using retrospective medical chart review. The indication for enrollment included: 1) Home-bound cases of the integrated home healthcare program of a community medical center; 2) Residents of a nursing home which is affiliated with this community medical center from January 1 to December 31, 2017 (Figure 1). These cases were enrolled during homecare visits. Most cases were clinically stable without specific symptoms. According to the service provided, home care

participants from the integrated home healthcare program were divided into four subgroups: home medical care (step (S) 0), home medical care (S1), intense home medical care (S2), as well as palliative care (S3) groups. They also met the inclusion criteria of disability.

The second group included residents from two separate institutions affiliated with our community medical center. The majority of our participants had varying degree of disability, even bed-ridden. They may have received medical follow up for their chronic disease at local clinics without regular US evaluation.

### 2.2. Measurements

The portable US machine we used was the "Diagnostic Doppler Ultrasound System" with a 3.5 MHz transducer type 5C2A developed by BenQ®. The overall sensitivity and specificity of US for detecting fatty liver were 93.6% (95% CI, 60.5-99.3) and 80.1% (95% CI, 53.3-93.4), respectively.<sup>5</sup> The sensitivity of USG for detecting gallbladder stones was more than 95%.<sup>6</sup>

The participants were all examined by attending physicians, who were all board certified Gastroentero-hepatologists. Scanning was done in diverse viewing planes necessary to obtain adequate images from liver, gallbladder, pancreas, spleen, kidney, pleural space, as well as peritoneal cavity. The findings were recorded in texts and images. This study was approved by the Institutional Review Board of Taipei City Hospital [TCHIRB-10701113-E].

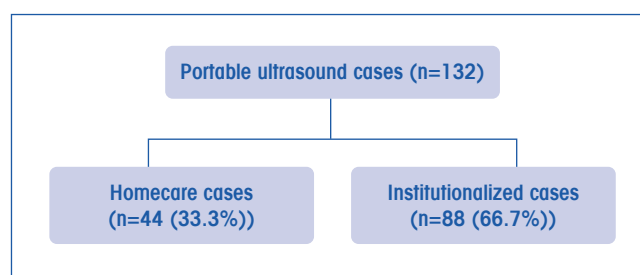
### 2.3. Statistical Analysis

We used participants' medical record to compare the general data, health condition and major diagnosis. Subgroup analysis was performed by place of residence (homecare V.S. institution), by age (<85 years old vs. ≥85 years old), and by gender (women vs. men). Chi-square test was used as appropriate. Non-parametric comparisons were employed in the comparisons between men and women (Fisher's exact test).

## 3. RESULTS

Among our participants, the age of homecare group was slightly older than the institution group (86.0±8.8

Figure 1. Flow chart of case recruitment.



**Table 1.** Baseline characteristics of the participants (n (%)).

Source Service provided	Total (n=132 (100%))	Home-care (n=44 (33.3%))					Institution (n=88 (66.7%))	p-value
		S0 (2.3%)	S1 (86.4%)	S2 (9.1%)	S3 (2.3%)	Total (100%)		
Age	84.5±8.4	82	85.8±9.1	89.2±7.4	83	86.0±8.8	81.5±10.4	0.017
Gender								
Men	66 (50.0)	0	24 (63.2)	2 (50.0)	0	26	40 (45.5)	0.196
Women	66 (50.0)	1 (100.0)	14 (36.8)	2 (50.0)	1 (100.0)	18	48 (54.5)	

vs. 81.5±10.4 years old,  $p=0.017$ ). The proportion between two genders revealed no difference (Table 1).

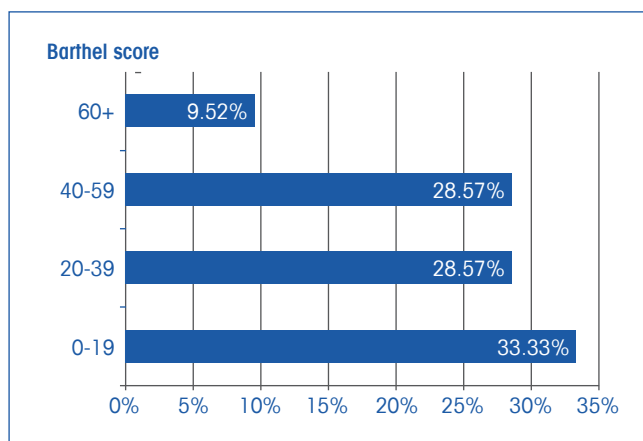
We compared the general conditions, such as consciousness, mood, comprehension, expression, respiratory status, feeding method, urination, and defecation, between male and female homecare participants. Expression was slightly better in women (Table 2).

We analyzed functional status using Barthel index for the homecare participants. Most (90.4%) of our homecare patients were at least partially dependent (Barthel index score <60) (Figure 2). Diabetes mellitus (22.7%), hypertension (22.7%), and cerebral vascular events (18.2%) were the most common comorbidities of our homecare patients (Figure 3).

The portable US examination revealed that the most common finding was fatty liver (25.0%), followed by gallstone (22.7%) (Figure 4). There was no difference in terms of gender and age between two groups. The prevalence of liver disease (including hepatic tumor, hepatomegaly, diffuse liver disease, liver cirrhosis, and intrahepatic calcification) in homecare group was significantly higher than institution group (38.6% V.S 8.0%,  $p$ -value <0.0001) (Table 3). Further analysis revealed that the difference mainly existed for liver cirrhosis (11.4% (n=5) in the homecare group V.S. 1.1% (n=2) in the institution group,  $p=0.027$ ).

#### 4. DISCUSSION

Homecare and long-term care are important issues

**Figure 2.** Barthel scores distribution of homecare participants.

in an aged population. The integrated homecare program improved accessibility to medical resources. However, US follow up was difficult because of conventional equipment limitation and inaccessibility. By using portable US, we provided this service despite spatial constraint.

The idea of POCUS was brought forward since 1990s. With technological advancement and experience accumulation, it was summarized and promoted by general practitioners in 2011.<sup>7</sup> From then on,

**Table 2.** General condition of the home-care participants (n (%)).

Characteristics	Women (n=18)	Men (n=22)	p-value
<b>Consciousness</b>			0.244
Clear	14 (77.8)	19 (86.4)	
Stupor	2 (11.1)	0 (0)	
Confusion	2 (11.1)	1 (4.6)	
Somnolence	0 (0)	2 (9.1)	
<b>Mood</b>			0.465
Stable	13 (72.2)	14 (63.6)	
Anxiety	1 (5.6)	5 (22.7)	
Depression	2 (11.1)	2 (9.1)	
Not evaluable	2 (11.1)	1 (4.6)	
<b>Comprehension</b>			0.961
Complete	12 (66.7)	15 (68.2)	
Good	4 (22.2)	5 (22.7)	
Partial	1 (5.6)	1 (4.6)	
Not evaluable	1 (5.6)	1 (4.6)	
<b>Expression</b>			0.038
Language	16 (88.9)	17 (77.3)	
Gesture only	0 (0)	5 (22.7)	
Can't express	1 (5.6)	0 (0)	
Not evaluable	1 (5.6)	0 (0)	
<b>Respiratory status</b>			0.790
Self	17 (94.4)	20 (90.9)	
Oxygen use	1 (5.6)	2 (9.1)	
<b>Feeding method</b>			0.211
Oral	15 (83.3)	21 (95.5)	
Nasogastric tube	3 (16.7)	1 (4.6)	
<b>Urination and defecation</b>			0.495
Self	4 (22.2)	8 (36.4)	
Assisted	9 (50)	10 (45.5)	
Incontinence	3 (16.7)	4 (18.2)	
Foley catheter indwelling	2 (11.1)	0 (0)	

more and more applications and researches were conducted. However, some points should be clarified before gaining its benefits.

First, the quality of imaging was compared between hand-held and high-end systems. Recent evidence summarized that when limited to distinct clinical questions such as ascites, pleural cavities, hydronephrosis, and abdominal aortic aneurysms, hand-held ultrasound devices may be comparable with high-end systems. Several articles reported the concordance for surveying cholelithiasis and guidance for paracentesis between two systems<sup>8</sup>. However, the evidence was weak due to small sample size and data heterogeneity. Further study is needed for and the clinical application of portable abdominal US.<sup>8</sup>

Second, ultrasonography is an operator-dependent examination. The training program was emphasized to make sure the competence of acquiring adequate results. False positive results may lead to unnecessary examinations and expenses, while false negative causes delaying of diagnosis and disease progression. Both should be avoided.<sup>4</sup>

Third, the indication of application may be considered. Due to the high rates (18.1% to 25.7%) of false positive were found in screening asymptomatic patients, whereas relatively lower rate (0.05%) in symptomatic patients receiving POCUS. Surveillance may be reserved for symptomatic patient to limit false positive results.<sup>9</sup>

Last but not least, patient safety remained the top priority. High standard of hygiene as well as adequate sterilization for machine, operator, and recipient should be achieved to avoid contamination.<sup>10</sup>

Beyond surveillances and procedures, the application of portable US was expanded to the palliative care at patients' living places. Mariani et al. reported their experience in palliative homecare patients in 2010.<sup>11</sup> Ekta Dhamija described their service of bedside ultrasound in palliative care in India in 2015.<sup>12</sup> Professor Shih and her colleagues described

portable US application in eight homecare cases in 2017.<sup>13</sup> The quality of palliative homecare may be improved by POCUS through condition evaluation and symptom relieving.

The data about homecare and institution patients are still insufficient. In our study, we approached 132 homecare and institution cases with portable US. The most common findings were fatty liver and gallstones. Fatty liver is considered to be very common in developed countries. In a report of elderly health examinees in Taiwan, the prevalence of non-alcoholic fatty liver disease was 48.1%. The prevalence of fatty liver reached the highest level at 40-60 years old, and tended to be lower in people older than 60 years old.<sup>14</sup> Non-alcoholic fatty liver disease was considered to be associated with metabolic syndrome. In our participants, old age and frailty were common, making fatty liver a less prevalent occurrence. This may be the explanation of the difference in prevalence between our patients (25.0%) and the general population.

Gallstones were found in 22.7% of participants, higher than general adult population (5.0%).<sup>15</sup> Similar to previous study, we found that gallstones were more common in women than in men. The prevalence increased with aging in previous reports. It is anticipated that 22.7% of our very old participants had gallstone. Besides, the complications increased with aging and lead to more surgical treatment.<sup>16</sup>

Beyond our expectation, homecare cases had more abnormal US findings than institutionalized cases. The reason may be related to the older age of the homecare cases. Other hepatobiliary findings showed significant difference between two groups. The major difference came from diffuse liver disease and liver cirrhosis. The participants of homecare group were older than the institution group (86.0±8.8 vs. 81.5±10.4 years old,  $p=0.017$ ) which may lead to more chronic inflammation and fibrosis by their underlying disease.<sup>17</sup> In addition, people with risk factors for liver cirrhosis, such as viral hepatitis, alcohol consumption and previous severe

**Table 3.** Comparison of ultrasound findings between home-care group and institution group (n (%)).

Findings	Total (n= 132)	Home-care (n= 44)	Institution (n= 88)	p-value
Fatty liver	33 (25.0)	12 (27.3)	21 (23.9)	0.831
Gallbladder stone	30 (22.7)	8 (18.2)	22 (25.0)	0.509
Negative	26 (19.7)	6 (13.6)	20 (22.7)	0.315
Renal cyst, hepatic cyst	30 (22.7)	9 (20.5)	21 (23.9)	0.826
Gallbladder polyp, chronic cholecystitis, cholecystectomy, common bile duct dilatation	22 (22.7)	11 (25.0)	11 (12.5)	0.117
Hepatic tumor, hepatomegaly, diffuse liver disease, liver cirrhosis, intrahepatic calcification	24 (18.2)	17 (38.6)	7 (8.0)	<0.001
Renal stone, hydronephrosis	21 (15.9)	8 (18.2)	13 (14.8)	0.801
Chronic renal parenchymal disease	11 (8.3)	4 (9.1)	7 (8.0)	0.824
Pleural effusion, pericardial effusion, ascites, bladder distension, benign prostatic hyperplasia	10 (7.6)	6 (13.6)	4 (4.6)	0.131

fatty liver condition might be denied of nursing home admission. Institution cases might be more stable in clinical condition as compared to home care cases. However, this speculation deserves further evaluation.

The periodical monitors of liver function test, blood pressure, blood glucose, and lipid profile in those patients with fatty liver were suggested.<sup>18</sup> For those with gallbladder stones, watchful waiting is the standard treatment. Most asymptomatic patients could be followed up with US every 6-12 months.<sup>2</sup> Diffuse liver disease is mostly associated with viral hepatitis. It's reasonable for patients with chronic hepatitis B virus or hepatitis C virus infection to

receive US every 6 months. In cirrhotic patients, a shorter 3-month interval can be applied.<sup>19,20</sup>

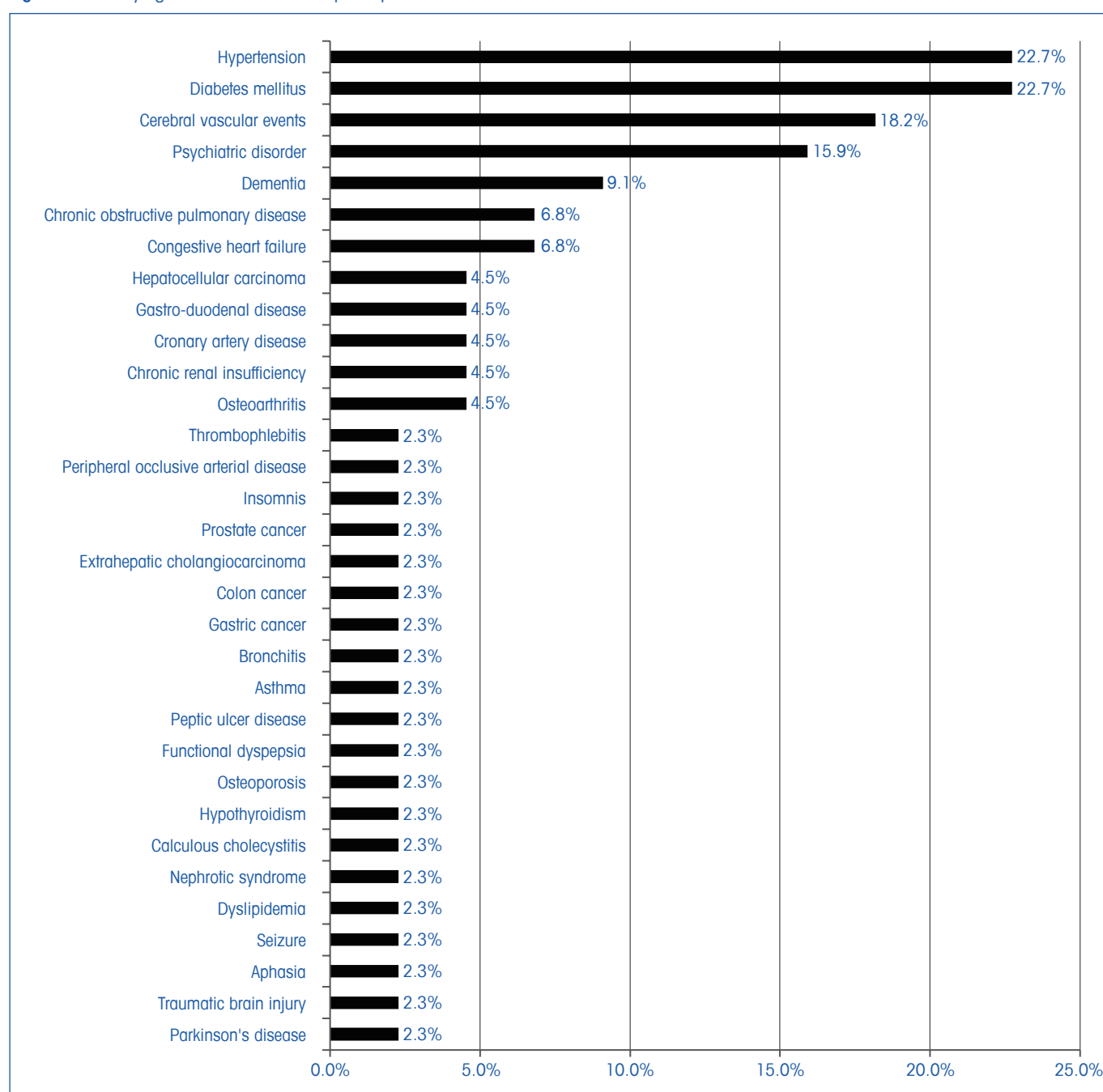
#### 4.1. Strengths

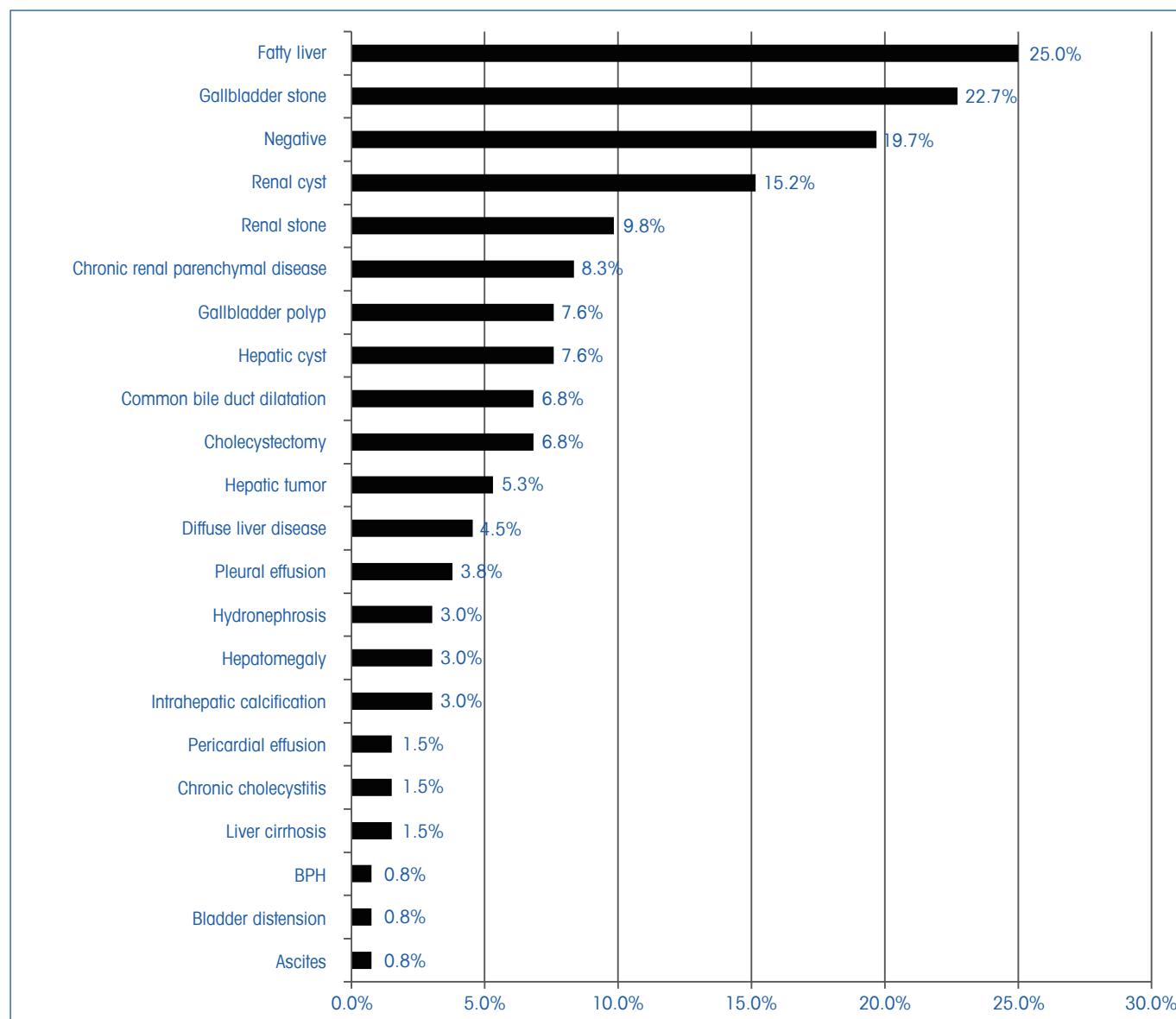
We compared abdominal sonographic findings among homecare and institutionalized cases. The sonographic findings of these homebound and vulnerable groups were rarely reported.

#### 4.2. Limitations

This study was retrospective without randomization, thus biases were unavoidable. There were no sensitivity or specificity assessments before and after

**Figure 3.** Underlying disease of homecare participants.



**Figure 4.** Total ultrasound findings and the frequency of occurrence.

examinations, neither was inter-observer variability. Further data about long-term care facility residents were lacking which made comparison between groups not possible.

## 5. CONCLUSION

Our study reported the application of portable ultrasonography in homecare and institutionalized elderly. According to our results, we suggested follow-up patients with fatty liver, gallstones, and liver cirrhosis in this special clinical setting.

Portable abdominal US can be a convenient and efficient option for disabled people with abnormal findings who require regular follow-up. We should understand its strength and weakness at current point, complete well-designed training program, and always keep patient safety in mind before performing examination.

## CONFLICTS OF INTEREST

The authors have nothing to declare.

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